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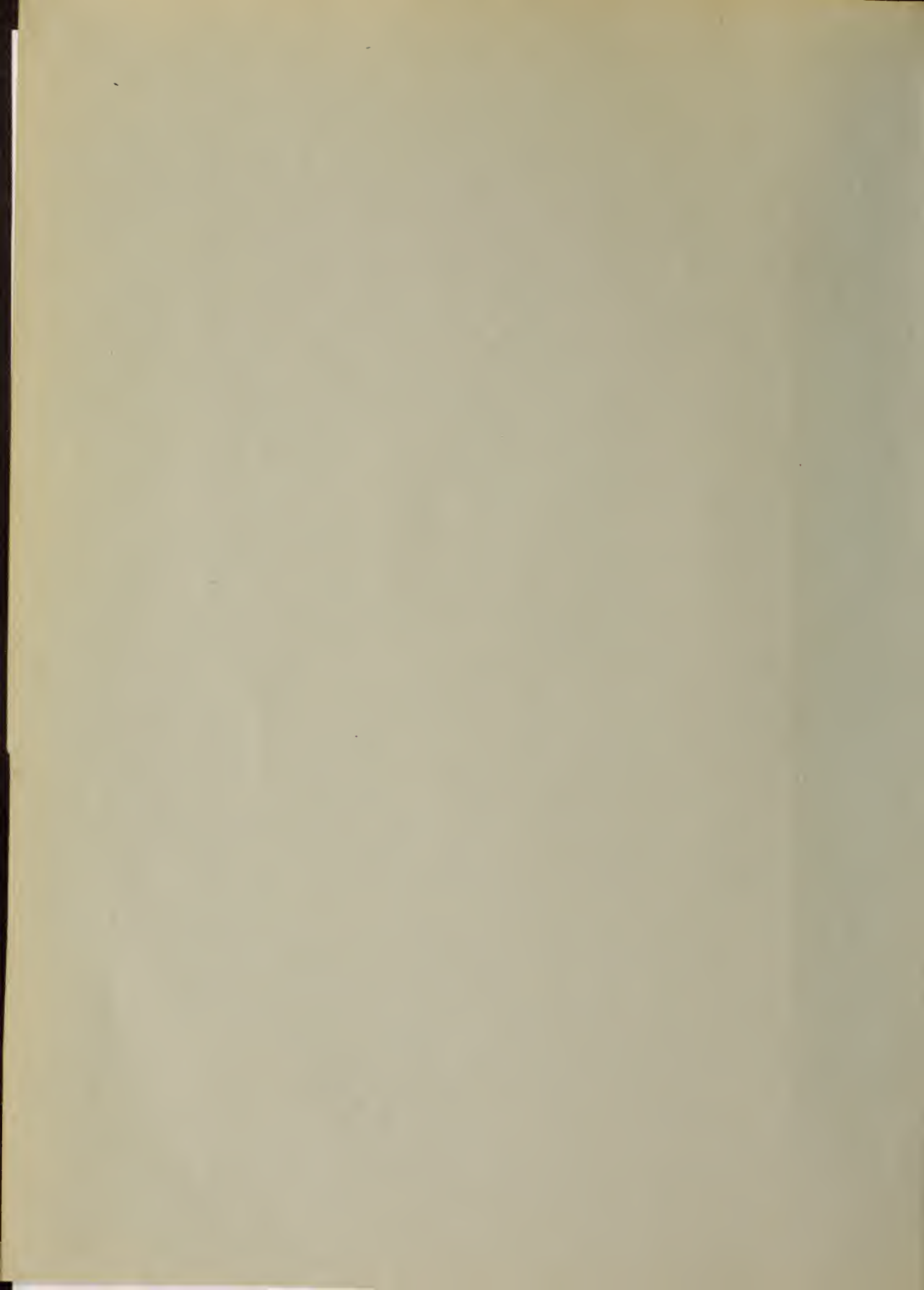
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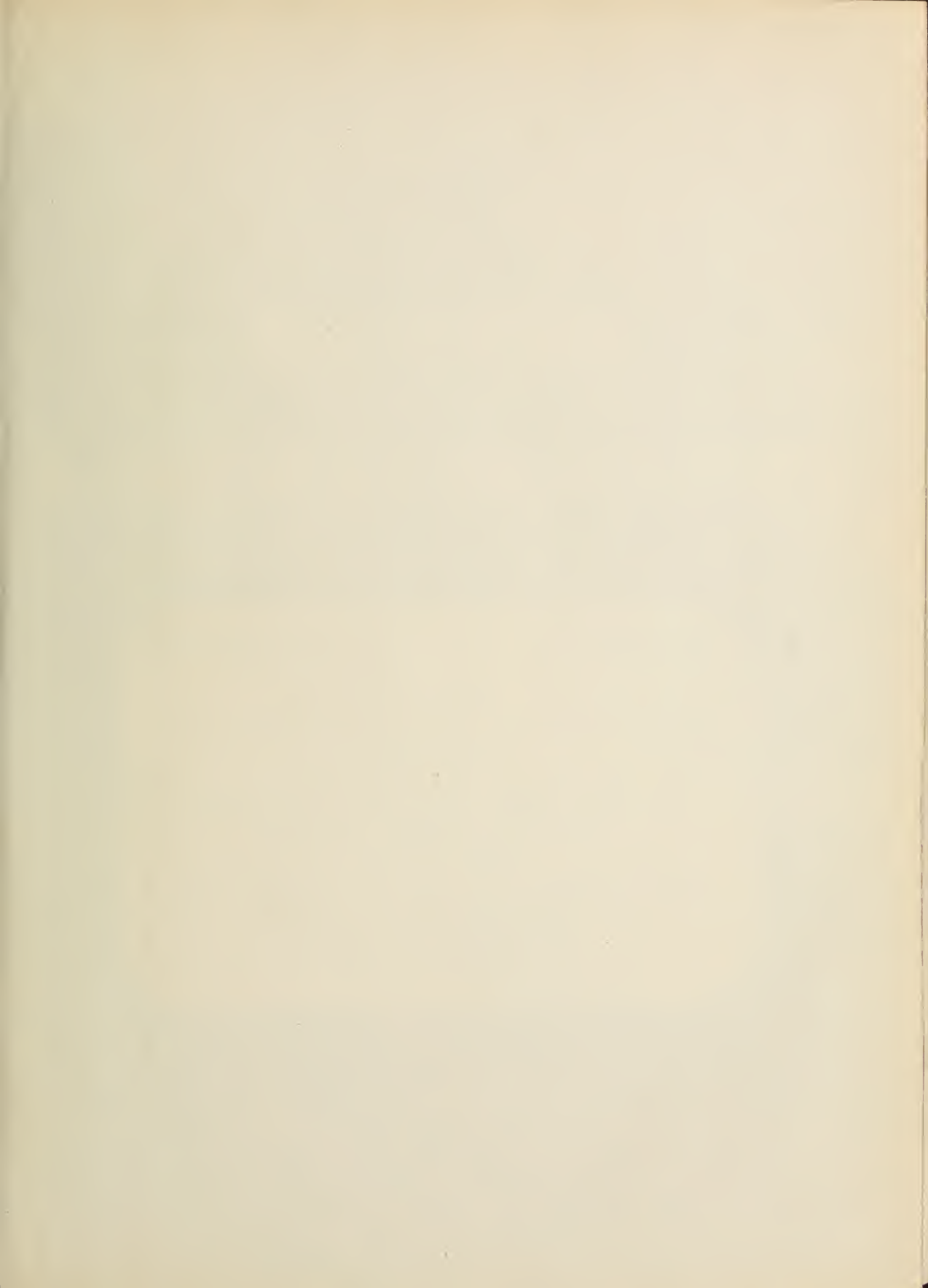
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# BRITISH KINEMATOGRAPHY

Volume 20, No. 1

January, 1952

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by John Halas

SURROUND BRIGHTNESS : KEY FACTOR IN  
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by S. K. Guth

INFLUENCE OF COLOUR OF SURROUND ON  
HUE AND SATURATION

by D. L. MacAdam

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# BRITISH KINEMATOGRAPHY

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## FILM PRODUCTION DIVISION

IT is a significant fact that, though film production in this country is at present at a low ebb, the Film Production Division of this Society has an ever increasing membership. Studio technicians are realising the importance of acquiring more knowledge of every aspect of the complexities of making films.

Until 1927, when the President of the Board of Trade, Sir Philip Cunliffe Lister (now Lord Swinton), introduced the Cinematograph Films Act (1927), film making was in the hands of very few people. The Films Act provided an enormous impetus to film production in this country and led to the construction of the modern studio. There was an immediate increase in the number of British films made as well as in the technicians to make them. With few exceptions, "footage" came before quality. The general attitude of technicians was non-progressive so far as concerned the exchange of technical information. The B.K.S. not having been formed. Charlatans abounded in the ranks of promoters, producers, directors and — unfortunately — technicians. The problems of cinematography, i.e. lighting,

processing, and later, sound recording, were approached unscientifically.

The formation of the British Kinematograph Society in 1931 received little attention at first, though reference to the early issues of the Society's Journal reveals a high standard of lecture, demonstration and discussion. Divisions of the Society were formed, and under the Chairmanship of the Past President, Mr. A. W. Watkins, the Film Production Division made a flying start. The principle aim of the Division was to keep members *au fait* with new techniques and equipment and to promote confidence in the exchange of ideas.

A stage has been reached when some of the educational courses are being repeated, so great has been the demand for enrolment.

The Film Production Division confidently claims to play an important part in the achievement of the technical excellence of modern British films. No progressive technician can afford not to be a member.

BAYNHAM HONRI, F.B.K.S., A.R.P.S.,  
*Chairman, Film Production Division.*

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# THE LATEST DEVELOPMENTS IN ANIMATED FILM

John Halas\*

THE advances that have been made in the animated film in recent years are twofold: aesthetic and technical.

From the outset, the tendency has always been for animated cartoon to incline towards a kind of burlesque music-hall stylisation. Most cartoons have been based on the exaggeration of physical forces, on the "hit him and chase him" style. As a result of this approach, audiences have now come to accept "gagging" automatically, as an inseparable part of the cartoon medium.

## The Aesthetic Advance

In recent years, however, we have been witnessing an entirely new development and that is the employment, in ever-increasing degree, of graphic art in animated pictures.

Since the early days of sound film animation has been moving towards naturalism. The objective, particularly in American cartoons, was to make the movement as lifelike as possible. Inventions such as Multiplane cameras and complex rostrum devices were nearly all designed to obtain the illusion of depth and naturalism, in imitation of the effects produced by live action cameras.

Nowadays, however, naturalism is out. In European studios and in some American studios the latest tendency is to ignore depth and make full use of the representative quality of cartoon by showing foreground, background and characters all on the same flat screen.

So cartoon is becoming stylised to a degree which pulls it away from the conventions of newspaper comic strips and which leaves us with characters which are true cartoon caricatures. These characters are animated mostly in two dimensions and make no attempt to conceal the fact that they are actual drawings. They recapture for us some of the charm of the very early cartoons drawn by Emil Kohl before cartoon production became industrialised.

When we consider the style of these new cartoons we shall find that they are profoundly influenced by modern design. Modern poster technique, for example, is reflected in the flat surface colour and modern architectural forms have influenced the shapes of objects as well as their colours.

This sweeping change of style, which has developed since the end of the war, has also had its effect on our approach to cartoon stories, which are now based far more on visual wit and visual symbolism than upon those twists of behaviour which had pride of place in the naturalistic type of story.

The limitations of the cartoon film as a film which is drawn are now accepted and cartoon stories no longer run entirely on "cat and mouse" lines. Fairy tales about cute little kittens are no longer the only approach to animation. As an example, the most popular cartoon character in America is a little boy called Gerald, painted in flat surface colours, drawn on the same simple lines that you may see in a cartoon in *Punch* or the *New Yorker*. As a character he cannot talk—he can only produce radio sound effects. The films in which he appears have the sophisticated charm and wit of our best humorous magazines.

This is a type of film where, for the first time, cartoon can give us intellectual satisfaction. At the same time, we discover that animation need not always be cute—it may even be artistic and intelligent and still be popular.

Aesthetic satisfaction apart, the new style has the added advantage of simplicity in execution. This in turn has economic advantages over the realistic approach which are of considerable benefit in these difficult English and European film markets.

## Technical Advances

Turning now to the technical advances





(By courtesy of Columbia Pictures Ltd.)  
Fig. 1. A still from "Gerald McBoing-Boing."

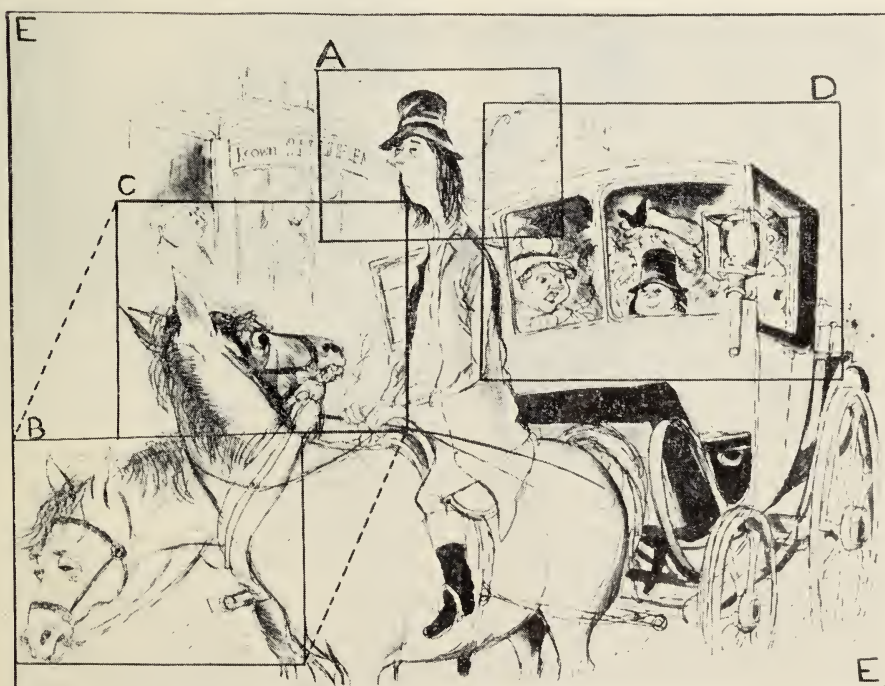


Fig. 2. A drawing which made up five different sequences for "John Gilpin," for the series "Painter and Poet." The lines indicate the various field sizes used in that sequence.

which have been made in the last few years, we shall find that several promising inventions seem to offer means of escape from the traditional methods, where a great number of laboriously painted celluloids are required to produce each simple effect. Frame by frame animation is expensive and experiments are in progress which may lead to short cuts.

Some of these experiments have already been seen at the Telekinema last year. We saw, for instance, some films based on still paintings, where the illusion of movement had been created by moving the camera. Live action cameras had been used before

editing of the frame sizes and length of each shot, it was proved possible to provide variety and smoothness of screen movement to the point where the audience were not conscious of the lack of animation within the still painting. It was also possible to allow enough time for the textures of the painting, interesting in themselves, to be fully appreciated.

By this method, stories just as complex as a fully animated cartoon film can be conveyed by paintings prepared for a fraction of the cost incurred by the orthodox animated film.

We saw two types of stereoscopic animation carried out by Norman MacLaren: the

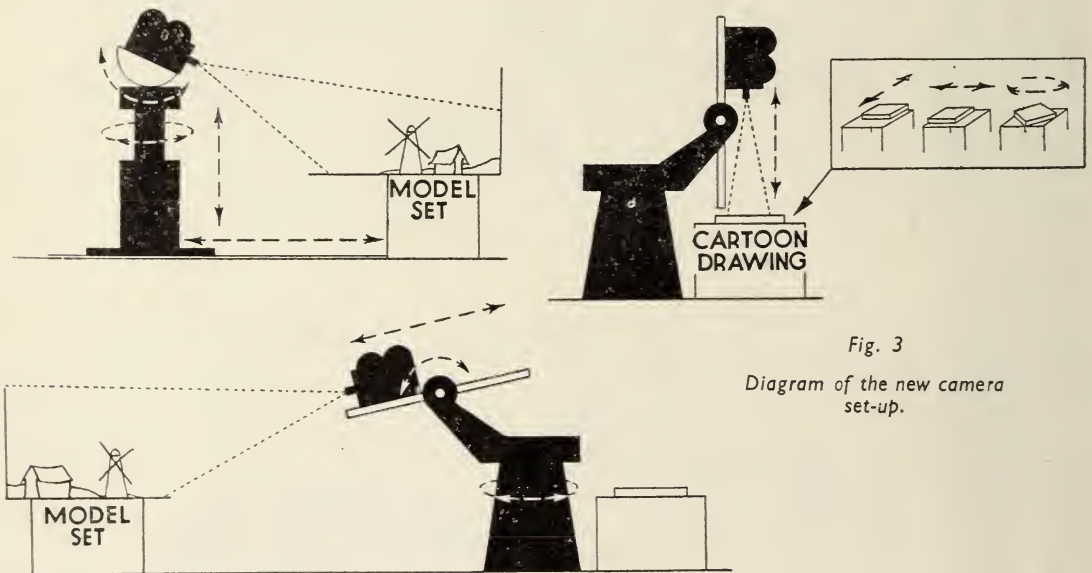


Fig. 3

Diagram of the new camera set-up.

both by the Americans and Italians to make films of the paintings of Old Masters. By skilful camera work and editing they were able to reveal to us new details in the paintings hitherto lost to the spectator.

For the "Painter and Poet" series of films, which our Studio produced for the Festival of Britain, a fixed rostrum camera was used instead of a live action camera. A few static pictures were painted for each film and it was left to the camera to provide the movement. The rostrum camera was able to range freely over each painting in any direction, now pulling back to survey a field 19 inches wide, now moving in to examine detail at close quarters. With careful pre-

animated type where depth in screen is achieved by adjustments of parallax in the right eye and left eye view respectively, and the stereogram type where only one view of the development of a geometrical design is shot and a stereoscopic effect is obtained by projecting two copies of the film a frame or two out of sync.

Meanwhile, we are looking forward to further developments in the use of Polaroid materials as a means of screening shapes and colours which can be controlled without frame by frame animation and so create a new form of abstract animated technique.

As regards equipment, little has been changed since last year; economy requires



that our camera set-up shall be capable of shooting as wide a range of different kinds of animation as possible.

It will be appreciated that, at these close ranges, the camera lens is behaving like a microscope; consequently, absolute rigidity of structure and mechanical accuracy are essential if the picture is to move smoothly. Control must be accurate to one thousandth part of an inch.



Fig. 4. The new camera set-up in use.

It will thus be seen that the camera and its mounting must needs be a massive piece of precision engineering, for, with all these movements superimposed on one another, all errors are cumulative.

Photography of animated models or puppets demands the same accurate control of camera and of the object photographed. But in this case the camera, instead of being

fixed looking vertically downwards, will be tilted at various angles between  $45^\circ$  and the horizontal, and will be required to pan or swing from side to side and to track backwards and forwards. Owing to the longer distances involved in model shooting and the unwieldy size of model sets, it is seldom possible to keep the camera still and move the object photographed, as in ordinary cartoon work.

But there are times when a subject calls for the employment of both methods in two or more separate exposures. It may be necessary, for instance, to superimpose animated drawings or captions on animated model in circumstances where laboratory optical superimposition would mean prohibitive delay and expense. To meet these conditions we must design a dual purpose mounting which will enable both exposures to be shot in register without unloading the film from the camera. For shooting models, this mounting must tilt, pan and track; for shooting cartoon, it must be held rigidly vertical, but must still track and must be provided with the usual panning table.

It would be a mistake, however, to expect a single mounting to be too versatile. In my own Studio the two principal Technicolor cameras are each capable of both cartoon and model photography, but each camera is adapted to a different range of shots.

In one case a Bell Howell camera is mounted on a slide permitting a track of 27 inches. The slide is held in the trunnion arms of a revolving pedestal, like a gun mounting, which can point the camera in any direction, including vertically downwards at a table of the type described.

In the other case a Bell Mitchell camera is located by pegs on either of two alternative brackets, one of which is fixed to a table rostrum for cartoon work and the other of which is mounted on a travelling pedestal which can tilt and pan and track for distances up to about 22 feet.

Both the arrangements allow the camera to proceed direct from model to flat cartoon photography without losing register in the camera, and with them it is possible to attempt a wide range of shots with confidence and accuracy.

## SURROUND BRIGHTNESS: KEY FACTOR IN VIEWING PROJECTED PICTURES

Sylvester K. Guth\*

*Reprinted from the Journal of the Society of Motion Picture and Television Engineers, Vol. 57, No. 3, September, 1951.*

THE brightness characteristics of various portions of the visual field surrounding the central or task area are of overwhelming importance in providing a comfortable visual environment.<sup>1</sup> These brightnesses, and their relationships to the brightness of the task, contribute favourably or unfavourably to the seeing conditions. They may influence directly the visibility of the visual task, or their effects may be more subtle and result in decreased ease of seeing. Obviously, both effects may be and often are produced simultaneously, especially when prolonged seeing is involved.

The difficulty of obtaining adequate auditorium brightness in theatres has often resulted in minimizing the importance of the surround brightnesses for ability to see and comfort of viewing. The lack of reports of discomfort has been used as one of the principal arguments for considering that there is nothing wrong with the existing viewing conditions. Such lack of complaints should merely be taken as the audience acceptance of what it is used to, just as it has done in many other fields. Since the motion picture is a visual task, the consideration of light and lighting can and should include the same factors that apply to other visual situations.

### BASIC CONSIDERATIONS

In order to understand the importance of the surrounding conditions in the central field, it may be well to consider briefly the relative magnitudes of the two areas. The angular extent of the entire binocular visual field varies with the individual physiognomy and averages about 200° horizontally and 130° vertically, and is approximately elliptical in shape. The limits of various portions of the visual field are illustrated in Fig. 1. The unshaded area indicates the

portion of the visual field in which objects can be seen by both eyes. The two shaded areas on the right and left represent those portions of the visual field that can be seen only by the right and left eyes, respectively.

### The Task Area

A visual task usually occupies a limited region in the central portion of the visual field and its apparent or visual size is a function of the distance from which it is viewed. A motion picture screen, for example, appears large or small depending upon whether it is viewed from the front or rear of a theatre. The three rectangles superimposed upon the visual field, illustrated in Fig. 1, represent a motion picture screen viewed from three different positions in an auditorium. In order to be applied generally to any size screen, the viewing distance is expressed in terms of the screen width,  $W$ . Thus, a screen viewed at a distance corresponding to the screen width,  $W$ , is represented by rectangle A, the angular extent of which is about 53° horizontally and 41° vertically. If the screen is viewed from the rear part of an auditorium, or a distance of  $5W$ , it occupies a much smaller portion of the visual field and may be represented by rectangle C. When viewed at this distance, it extends approximately 11° horizontally and 8° vertically. The intermediate rectangle B corresponds to a viewing distance of about 3 times the screen width. It should be noted that in some theatres a screen may appear even smaller than the one indicated by C.

It is seen that even when the screen is viewed from a short distance, it occupies a relatively small portion of the binocular visual field. The importance of the peripheral regions can be emphasized by considering the relative areas involved. A convenient and expressive unit of apparent

\*General Electric Co.



area is in terms of the solid angle,  $Q$ , in steradians,\* subtended by a surface which combines the actual projected area with the distance from the eye to the centre of the surface. Thus, the relative extent of a surface can be expressed as a percentage of the total solid angle subtended by the entire binocular visual field which is approxi-

$2W$ . A more significant comparison is the solid angle in steradians subtended by the screen and the per cent. of the visual field occupied at various viewing distances. Except for those who sit very closely to the front of the theatre, the screen occupies less than about 4% of the visual field, and for the average viewer less than 1%. Thus,

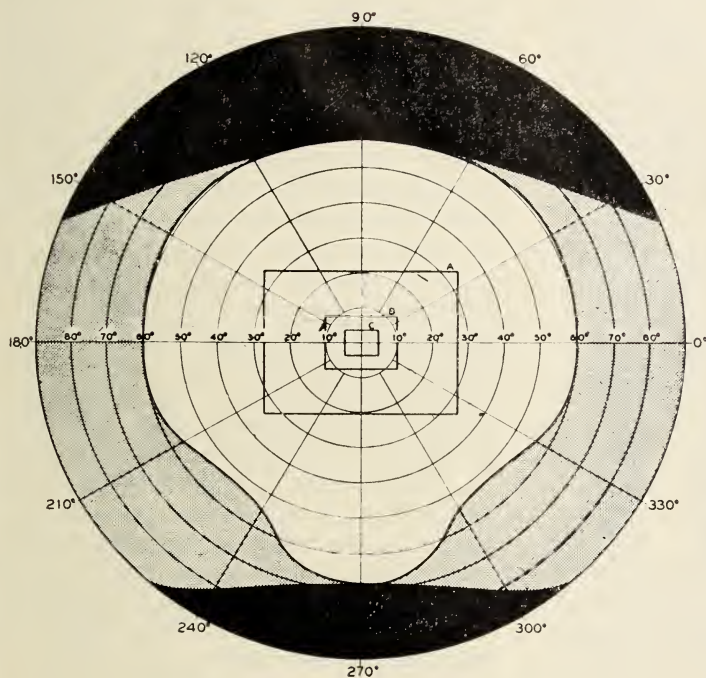


Fig. 1

A diagrammatic representation of the monocular and binocular visual fields. The portions occupied by a motion picture screen when viewed at three distances, corresponding to the screen width  $W$ ,  $3W$  and  $5W$ , are illustrated by rectangles A, B and C, respectively. Shaded areas (right and left) represent portions of the visual field seen only by the right and left eyes, respectively. Unshaded area represents that portion of the visual field seen by both eyes.

mately 5 steradians. The solid angle subtended by a motion picture screen is dependent upon its actual size and the distance from which it is viewed, and both of these may vary over a considerable range. However, when the viewing distance is expressed in terms of the screen width,  $W$ , it is possible to illustrate the ranges of apparent sizes of screens as in Table I. It is seen that as the viewing distance increases, the angular extent of the screen diminishes rapidly between  $W$  and  $2W$ , and progressively more slowly for distances greater than

it is obvious that the magnitude of the peripheral region of the visual field makes it extremely important to the viewer of projected pictures. Consequently, this area cannot be neglected when designing the lighting for comfortable seeing conditions.

When it is considered that the viewing of projected pictures involves a dynamic rather than a static visual situation, the area immediately surrounding the screen becomes even more important. In order to see all of the picture details, the eye may rove over the entire screen, the angular movement depending upon the viewing distance. Thus, at times, the line of vision may be directed toward the edge of the screen and then the screen surround is close to the line of vision. For the longer viewing distances, a rela-

\*The solid angle,  $Q$ , in steradians is equal to the projected area of a surface divided by the square of the distance from the surface to the eye; i.e.,

$$Q = \frac{A}{D^2}$$

tively small angular movement of the eyes will bring the screen surround into nearly direct view. Therefore, unless the surround brightness has been properly adjusted, the viewer is faced with a considerable variation in adaptation brightness which can do nothing but detract from his pleasure and comfort by providing an undesirable visual environment.

When designing lighting, it is necessary to consider the various characteristics and requirements of the visual task. While the viewing of projected pictures usually involves prolonged periods, the task involves some factors that are different from those pertaining to other tasks such as reading.

**Table I**  
**The Visual Size and Area of a Screen when Viewed at Various Distances**

Viewing distance in screen widths	Angular subtense of screen degrees		Solid angle subtended by screen steradians	Per cent of visual field
	Width	Height		
1W	53.1	41.1	0.75	15.0
2W	28.1	21.2	0.19	3.8
3W	18.9	14.3	0.083	1.7
4W	14.3	10.7	0.047	0.94
5W	11.4	8.6	0.030	0.60
6W	9.5	7.2	0.021	0.42
7W	8.2	6.1	0.015	0.30
8W	7.2	5.4	0.012	0.24

Much of the information of the story is obtained by words and the gestures, facial expressions and actions of the performers. Therefore, visual acuity is less important than the discrimination of a wide range of brightness contrasts. The viewer is not confronted with the problem of resolving small details near the threshold in size. However, while discrimination of the characteristics of the visual task may not be critical, the eyes and attention are focused steadily with but brief respites.

#### **Adaptation Brightnesses**

In any specific situation, the desirable surround brightness is dependent upon the brightness level to which the eyes are adapted. Therefore, it is necessary to determine the relationship between the picture brightness and the surround brightness. However, the former varies over a considerable range, depending upon projection-

equipment, theatre and screen sizes, film characteristics, etc. It may range from a very low level for the opaque projectors used in educational work to the high levels obtained with slide projectors. Nevertheless, it is possible to develop a concept in terms relative to the screen brightness obtained with the projector running without film. Furthermore, since a motion picture, or any sequence of projected still pictures, presents a continuously variable brightness pattern, it is difficult to arrive at any specific brightness that can be considered representative of all conditions. One method is to record the variation in integrated or average-picture brightness for a typical film and to determine the mean brightness over an extended period of time. However, the range of average brightness, especially the minimum values, are of importance.

A typical record for a black-and-white film is shown in Fig. 2. The film used included photographs of almost completely white areas to extremely dark night scenes and can be considered to be representative. In order to make the record of Fig. 2 more universal in its application, the ordinate is shown as per cent. of clear-screen brightness. Thus, it is a simple matter to convert the relative values to actual brightness. For example, in terms of the clear-screen brightness, the maximum average brightness recorded for the lightest scene was about 25%; the minimum brightness was 1.0%; and the mean value for the entire film was about 10%. Therefore, when the clear-screen brightness is 15 ft-L, the picture brightnesses are approximately 3.8 maximum and 0.15 minimum with a mean of 1.5 ft-L. It is interesting to note that these values compare favourably with those obtained by Logan.<sup>2</sup>

A similar record taken with an industrial colour film gave a mean brightness of about 5% of the clear-screen brightness with maximum and minimum values of 16% and 1%, respectively. For a clear-screen brightness of 15 ft-L, these brightnesses are a mean value of 0.75, a maximum of 2.4, and a minimum of 0.15 ft-L. Obviously, there will be quite a wide variation among

films. However, these brightnesses appear to be within the range of what is obtained in representative theatres.

### EXPERIMENTAL ARRANGEMENT

In order to isolate and to control independently the brightness of the various areas in the visual field, the experimental arrangement illustrated in Fig. 3 was adopted. This is a modified scale model of a theatre in which 1 in. equals 1 ft. The screen was 20 in. wide, thus corresponding to a 20-ft. screen. The observers were located at a distance of six times the screen width from the plane of the screen, or a distance of 120 in. Immediately surrounding the screen was a transilluminated diffusing glass, the brightness of which could be adjusted by

In the present investigation, which was intended only to be exploratory, clear-screen brightnesses ranging from 1.1 to 60 ft-L were used. These include brightnesses that are obtainable with various types of projection equipment such as highly efficient projectors used at a relatively short projection distance, opaque projectors, slide-film projectors, etc. The brightnesses were obtained with a standard 16 mm. projector in which were used lamps of 200, 300 and 750 W for screen brightnesses of 11, 25 and 60 ft-L, respectively. By means of a neutral-density filter, these brightnesses could be reduced to one-tenth of these values for a lower range of 1.1, 2.5 and 6 ft-L. These clear-screen brightnesses corresponded

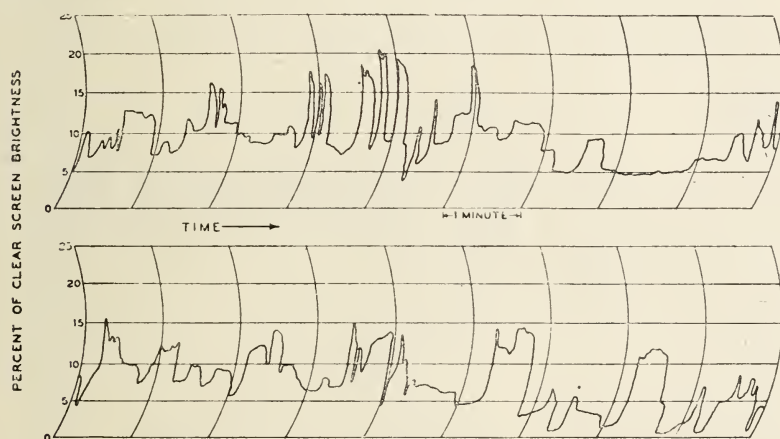


Fig. 2

*A record illustrating the variation in integrated or average brightness of a typical motion picture in terms of the clear-screen brightness.*

the observers. This area corresponds generally to the area on a stage surrounding a motion picture screen and is termed the screen border. Between the observer and the screen was a panel, the brightness of which could be independently controlled. The observer viewed the projector screen through a rectangular aperture in the panel. This aperture was of such a size that the transilluminated screen surround could be seen by the observer. This arrangement enabled control of the two surround brightness without permitting any stray light to reach the screen. While this experimental arrangement does not duplicate exactly the visual situation of a theatre, it is considered to be sufficiently typical for the present purposes.

to mean picture brightnesses ranging from 0.1 to 6 ft-L.

The observers viewed the motion picture and, for each value of clear-screen brightness, adjusted the brightness of the border until they deemed it most desirable for viewing the projected picture. Their judgment was based upon viewing comfort and upon the appearance of the projected pictures. A group of five observers made a series of five observations on each of two sittings for the various screen brightnesses. Each observer was permitted as long a period to make each observation as he felt necessary. Each series of observations included representative portions of the motion picture.



## EXPERIMENTAL RESULTS

### Influence of Screen Brightness

The average brightnesses of the border selected by the observers are plotted in Fig. 4 for clear-screen brightness ranging from 1.1 to 60 ft-L. The observed data for viewing motion pictures are represented by the open circles. These points can be represented by a straight line, indicating a linear relationship between the logarithms of the clear-screen brightness and the selected border brightness. Since the average-picture brightness is approximately one-tenth of the clear-screen brightness the scale at the top of Fig. 4 illustrates the average-

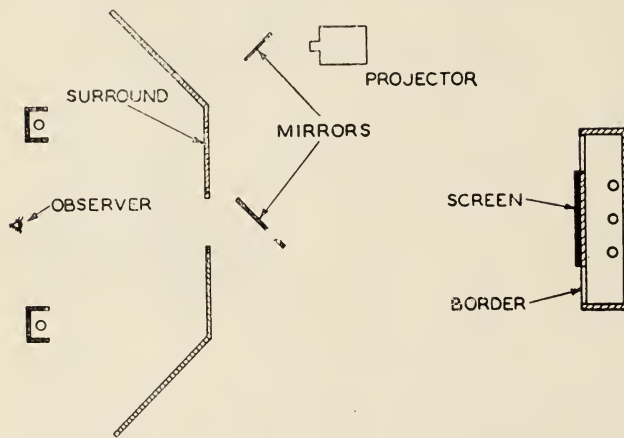


Fig. 3

*The experimental arrangement used for determining the desired border and surround brightness when viewing projected pictures.*

projected-picture brightnesses for corresponding clear-screen brightnesses. The picture brightness is a more representative value, since it can be considered as the brightness to which the eyes are adapted.

A similar investigation was conducted with a typical black-and-white slide film. The solid dots indicate the average border brightnesses selected by two of the observers for four screen brightnesses, ranging from 1 to 20 ft-L. These values check very well with those obtained with motion pictures. In other words, the fact that the observer is viewing a still or motion picture does not seem to influence his decision regarding the most suitable border brightness. Similar results were obtained with a colour film.

It was found that the surrounding screen brightness had no significant effect upon

the selection of the border brightness, provided that it was equal to or less than the latter. None of the observers desired a zero surround brightness. The general preference was about one-half the border brightness. All who viewed the projected pictures in the experimental situation were unanimous in indicating that the border brightness was of greatest importance. Therefore, the following discussion is based primarily upon the border brightnesses selected by the observers for the various screen brightnesses.

The desirable border brightness is not a simple function of the clear-screen or average-picture brightness, but is exponen-

tial, and may be represented by:

$$B = 0.16 S^{0.45}$$

$$\text{or } B = 0.46 P^{0.45}$$

where  $B$ ,  $S$  and  $P$  are the border, clear-screen and mean-picture brightnesses, respectively. A simple approximation is that the border brightness is equal to the square root of the screen (or picture) brightness multiplied by a constant. In terms of average-picture brightness, the desired border brightness is indicated to be about one-half of the square root of the picture brightness.

It may be of interest to compare the above equations with one developed from data obtained in an earlier investigation of comfortable brightness relationships in interior lighting.<sup>3</sup> The relationship between the brightness,  $B$ , of a light source and the

brightness,  $F$ , of the adapting field was found to be :  $B = 302 F^{0.44}$

In the three equations, the brightness of a light source or luminous area outside of the region of a visual task is expressed as a function of the brightness to which the eyes are adapted. The coefficient is dependent upon the criterion, the visual sensation being studied and other experimental factors. However, the similarity between the exponents is particularly significant and illustrates a common basis for the two investigations. Since most visual functions follow well-established laws and patterns, it should be expected that similar relationships would be obtained.

higher picture brightnesses than for the lower picture brightnesses. This is understandable, since an important factor is the total luminous flux directed toward the eye by the area surrounding the screen. Furthermore, the eyes become progressively more sensitive to brightness differences as the adaptation brightness is increased. Therefore, relatively lower border brightnesses will be selected for the higher picture brightnesses. Nevertheless, these indicated desirable border brightnesses are considerably higher than those indicated by other investigators.<sup>2, 4</sup>

It is emphasized that the technique used in this investigation eliminated the factor of

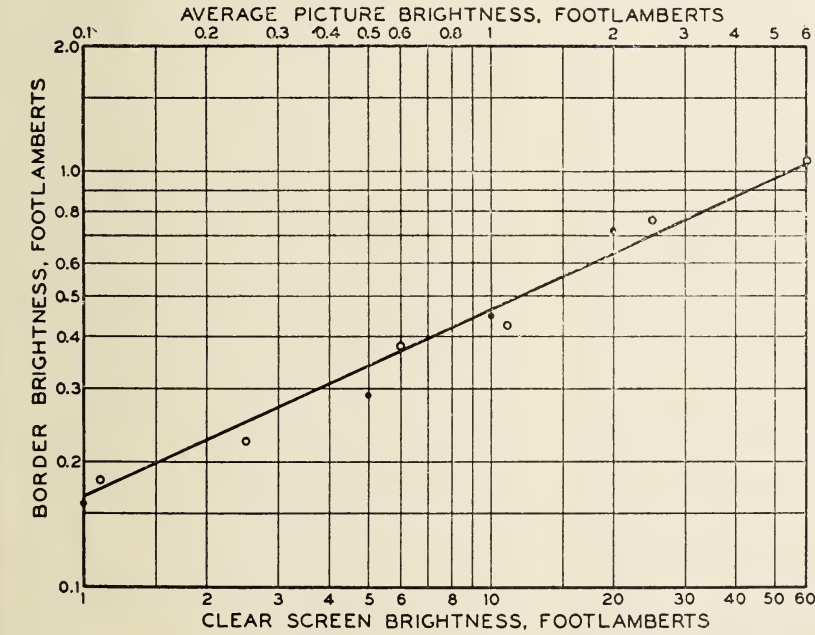


Fig. 4

The relationship between desired border brightness for various clear-screen and average-picture brightnesses. The open circles and solid dots represent observed values obtained with a motion picture and slide film, respectively.

The ratio between the border and picture brightnesses is a variable one. For example, when the picture brightness is 0.2 ft-L (corresponding to a clear-screen brightness of 2 ft-L), the indicated border brightness is 0.222 ft-L. This is approximately equal to the average-picture brightness. However, when the picture brightness is 2 ft-L, the desired border brightness is 0.63 ft-L or about one-third of the average-picture brightness. In other words, relatively lower border brightnesses are desired for

stray light upon the screen. These relatively high border and surround brightnesses may be impracticable in existing theatres. Nevertheless, these results do indicate that under ideal conditions, higher brightnesses are desirable. They should be obtainable in a properly designed auditorium.

**Stray Light**

In the usual auditorium, a limiting factor which governs the permissible surround brightness is the amount of stray light reflected upon the screen. Therefore, a brief

investigation was made to determine the amount of stray light which would produce a just barely perceptible effect upon the picture quality. A small source of light, mounted on the rear of the surround screen, was variable and controlled by the subject. This source provided a variable amount of stray light upon the picture screen. The observer viewed the projected picture, simultaneously varying the amount of stray light until he deemed it to be a maximum without affecting the quality of the picture. This was investigated with two picture brightnesses. When the picture brightness was 0.50 ft-L (clear-screen brightness equal to 5 ft-L), it was found that a stray-light brightness of about 0.07 ft-L produced no effect upon the picture. For a picture brightness of 3 ft-L (30 ft-L clear-screen brightness) the stray light could be increased to 0.15 ft-L.

Referring to Fig. 4, it is seen that the border brightness for a picture brightness of 0.50 ft-L is 0.33. Thus, the stray-light brightness is about one-fifth of the border brightness. A similar ratio was found for the picture brightness of 3 ft-L, where the desired border brightness was 0.76 ft-L and the permissible stray light was 0.15 ft-L.

### Colour Film

A similar brief investigation was made with a colour film. While the one used may not be exactly representative of the usual production films, it does make possible a qualitative appraisal of desired border and stray-light brightnesses. The average-picture brightness was found to be about 5% of the clear-screen brightness, which is half of the average-picture brightness of the black-and-white film. This is lower than that found by Logan,<sup>2</sup> whose measurements indicated a higher average-picture brightness for colour film than for black-and-white film. The results obtained with two observers indicated that the border brightness desired when viewing the colour film corresponded to that obtained for the black-and-white film. In other words, it appears that the border brightness is a function of the average-picture brightness and that

viewing colour pictures has no measurable effect upon the desired brightness.

On the other hand, it was found that stray light upon the screen was more effective for colour film than for black-and-white film. For equal picture brightnesses, the maximum tolerable stray light for viewing colour film was about one-half that found to be tolerable for black-and-white film. These results are logical and to be expected. The shading and blending of colours and their contrasts are important factors in the appearance of projected colour pictures. On the other hand, a black-and-white picture involves a range of neutral values which are merely shifted slightly to lighter tones by the stray light. For example, in the latter case, for an average-picture brightness of 1 ft-L, it is assumed that the white and black brightnesses are 5 and 0.05 ft-L, respectively. The tolerable stray light for this condition would be about 0.10 ft-L (one-tenth of the average picture brightness). Calculated values of contrast between the black and white areas without and with stray light are 99% and 97%, respectively. Similar calculations for other picture areas yield correspondingly small changes in contrast. In other words, the stray light selected as maximal tolerable produces too small a change in contrast to be significantly visually effective. Calculations for colour pictures would be considerably more complex since they would have to involve a consideration of colour change as well as a change in brightness. The former probably is the reason for a lower tolerance of stray light when viewing colour pictures.

### CONCLUSIONS

The relationships between average-picture brightness, border and surround brightnesses, and the stray light make it possible to predict or to predetermine the conditions that are expected to be most satisfactory in any theatre. A simple rule would be to raise the border and surround brightness to the value that will not produce an excessive level of stray light upon the screen. Of course, the brightness of the border should not exceed that found desirable for the avail-



able average-picture brightness. For example, for a typical theatre, if the clear-screen brightness is 10 ft-L and the average-picture brightness is 1 ft-L, the border brightness should be about 0.45 ft-L, but the stray light should not produce a brightness greater than 0.09 ft-L.

The values of border and surround brightnesses indicated by this investigation are somewhat higher than those published by others.<sup>2, 4</sup> A review of the limited literature on the subject indicates that most of the values have been based upon empirical attempts to apply data obtained with experimental and environmental conditions that are not directly applicable to the viewing of projected pictures. Nevertheless, there is the common conclusion that some brightness is required in motion picture theatre auditoriums.

Another important aspect of brightness in viewing areas is the sources which produce the low brightnesses on the border, walls, ceiling and floors. At the low visual adaptation levels these sources and any other areas of relatively high brightness must be kept to a minimum in order for them not to be distracting or even uncomfortable. A method has been developed for determining the tolerable brightnesses of sources, such as aisle lights, bright areas of walls, fixtures, etc. In essence, they must be reduced in brightness and area so that their visibility does not compete with the visibility of the projected picture. The permissible brightnesses of such areas is a function of the size of the source or bright wall area, its position in the visual field and the average-picture brightness. This method has been described in detail elsewhere.<sup>3, 5</sup> While it was not developed for the projected picture prob-

lem, the general principles involved should be applicable to any visual environment.

There are other factors which may have an important influence upon the final accepted or desirable surround brightnesses. These include, especially, the psychological factors which govern the mood of, and impressions gained by the viewers. In other words, the actual brightness level used should enhance the illusions being created by the motion picture. Theoretically, at least, the viewer is asked to place himself in the actual situation being created on the screen, be it the hot sunlit desert or the dark, mysterious passageways of a haunted house. Environmental brightnesses must enhance and not destroy these effects. Thus, there are many aspects of the problem of providing the surround brightness for viewing the projected pictures. Ultimately, all of them must be investigated before their individual importances in any situation can be evaluated. Perhaps a semi-variable control system will be necessary. Whatever is required should be determined by carefully conducted investigations rather than empiricisms or opinions.

It is emphasized that the investigations and results presented in this paper are exploratory. A primary purpose was to develop a technique that would enable observers to make considered appraisals of the environmental brightnesses in an experimental situation that approximated actual viewing conditions. Since the observers used in these studies have been used in a number of earlier investigations, and were selected as being representative, it is believed that the brightnesses selected by them are indicative of the levels that are desirable.

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## INFLUENCE OF COLOUR OF SURROUND ON HUE AND SATURATION

David L. MacAdam\*

*Reprinted from the Journal of the Society of Motion Picture and Television Engineers, Vol. 57, No. 3, September, 1951*

THE appearance of a projected colour picture depends on the state of adaptation of the audience. This is governed by the picture itself, by its predecessors within the past few minutes, and, to an important extent, by the colour of the light in the field of view surrounding the screen. This last factor is the subject of this paper.

The effects of adaptation to various surrounding colours are qualitatively well known. Usually the picture appears to be off balance, with a predominant hue approximately complementary to the colour of the surroundings. For this reason, chromatic surroundings are frowned upon by some makers of colour films. Furthermore, even a neutral surround, albeit rather low in intensity, stabilises the adaptation of the audience and causes them to notice unintentional variations of balance in a film. In an almost completely darkened theatre, the projected picture governs the adaptation of the audience so as to compensate, more or less completely, for accidental variations of balance. Any illumination of portions of the visual field near the screen provides a reference white, so that variations of balance become more noticeable. For this reason, some makers of colour films strongly recommend that the light in the surroundings be kept to the bare minimum required for safety.

Considerably more than the statutory minimum is necessary for comfort and "good seeing." Therefore it seems desirable to have some quantitative data concerning the effects of the colour of the surround on the hues and saturations perceived in projected pictures. Such data

may indicate the best colours for surrounding illumination, so as to obtain optimum safety, comfort and vision with minimum disturbance of the hues perceived in the picture. Adequate data may indicate some condition of balance which, paired with a particular quality of light in the surround, will cause the least perceptible effects for normally expected variations of balance and auditorium lighting.

To obtain and show such data, it is necessary to employ a method of measuring colours which is independent of variations of adaptation of the observer. With such a method, it is possible to determine the variations of measured colours which are required to produce equivalent effects under various conditions of adaptation.

A method, of the kind required for measuring colours and for representing the effects in which we are interested, was recommended in 1931 by the International Commission on Illumination. It was adopted by the American Standards Association as a War Emergency Standard in 1942, and has recently been reaffirmed as a regular American Standard.<sup>1</sup> The method has been described previously in the S.M.P. & T.E.<sup>2, 3</sup> The chromaticity diagram, which is commonly used to represent the results of colour measurements, is very useful for representing and interpreting the results of quantitative research on colour vision. Any colour is always represented by a fixed point in the chromaticity diagram, regardless of the effects of adaptation in changing the perceptions arising from that colour. This property of the chromaticity diagram implements the psychophysical definition of colour<sup>4</sup> as "characteris-

\*Eastman Kodak Co., Rochester 4, N.Y.

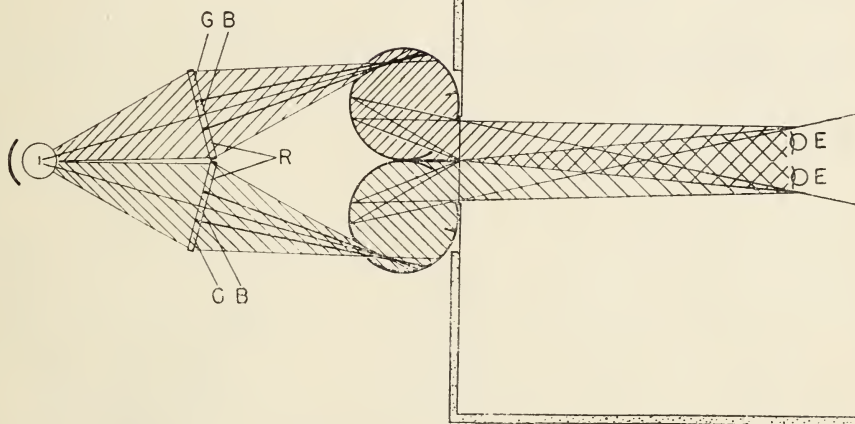


tics of light." These characteristics are independent of the state of adaptation of the observer. On the other hand, the chromatic attributes, hue and saturation, of the sensation resulting from any colour, depend very much on the observer's state of adaptation. The co-ordinates of the point representing a colour do not change, but hue and saturation do, when the colour of the surround is changed.

The experimental arrangement used to get the desired data is indicated in Fig. 1. This is a horizontal cross-section through a twin colourimeter, the observing room, and the observer's eyes.<sup>5</sup> The amounts of light passed by the red, green and blue filters, R, G, B, are varied by rectangular dia-

Fig. 1

Schematic diagram (horizontal cross section) of twin colourimeter, observing booth and observer's eyes.



phragms, moved in vertical slots by remote control. These beams are mixed in the interiors of two hollow white spheres. The blended light within the spheres is viewed through portions of two plastic Fresnel lenses. They appear as two adjacent semicircles. They are surrounded by a fluorescent cloth which glows with light of whatever colour is desired. The cloth is irradiated with ultraviolet energy, which excites the surround but does not contaminate the colours of the light in the central field.

Fig. 2 shows series of points in the chromaticity diagram. Each series represents

colours of various saturations, all of which appear to have the same hue when seen with a black surround. The point W represents the colour which appears to be white when no other colours are visible. The innermost point on each curve represents the colour which appears to be white when the adjacent semicircle has the colour represented by the outermost point. The differences between W and the innermost points, therefore, represent the effects of simultaneous contrast, and indicate possible effects of various colours in a picture on the appearance of neighbouring colours in the picture.

Fig. 3 shows series of colours which appear to have constant hue when sur-

rounded by light matching the chromaticity of a black body at 3200 K. These curves are entirely different from the preceding ones. Their centre of convergence represents a colour that appears white when seen alone in such surroundings. The innermost point on each curve represents the colour that appears white in such a surround, when seen side by side with the saturated colour represented by the outermost point. Fig. 4 shows the constant-hue series and the effects of simultaneous contrast in a blue surround, the colour of which is indicated by the cross. Fig. 5 shows constant-hue curves and the

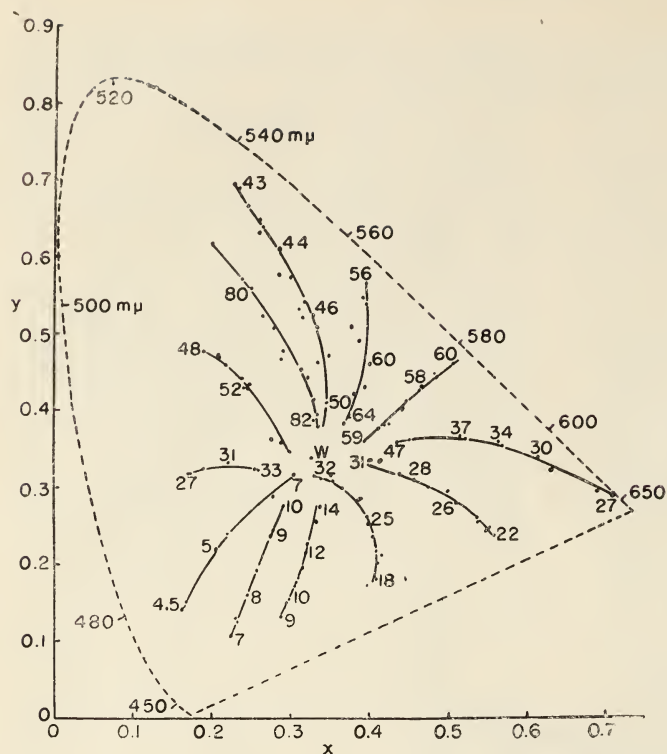


Fig. 2

Loci of constant hue in dark surround. Luminances (foot-Lamberts) necessary for constant brightness for each hue are shown by numbers printed near typical points. Different hues are not necessarily equally bright.

Fig. 3  
Loci of constant hue for surround of approximately tungsten-light quality. Luminances for constant brightness are shown numerically.

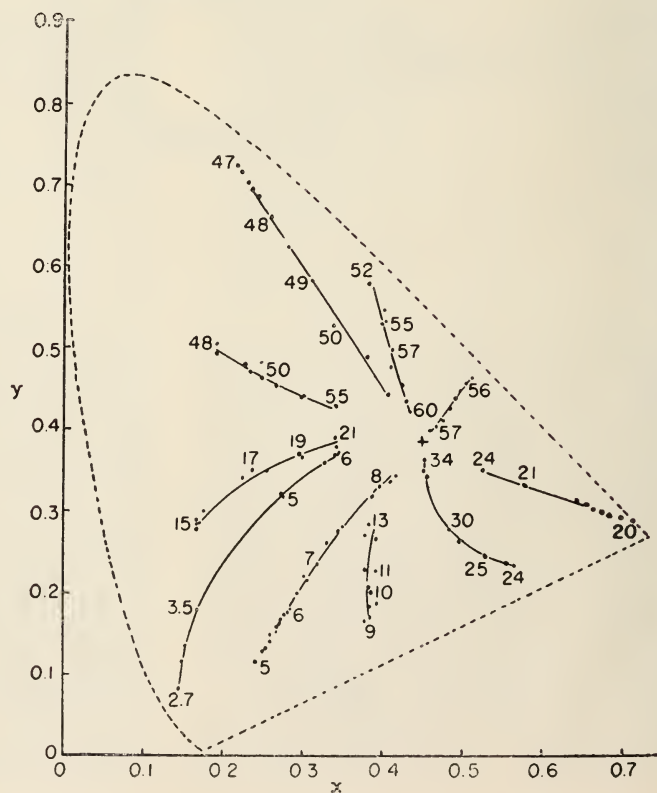


Fig. 4

Loci of constant hue for blue surround (shown by cross).

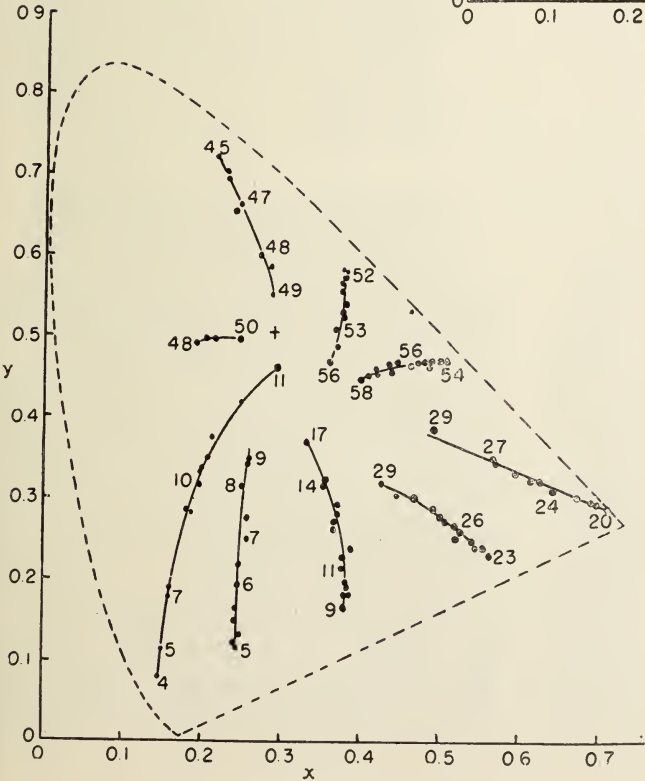
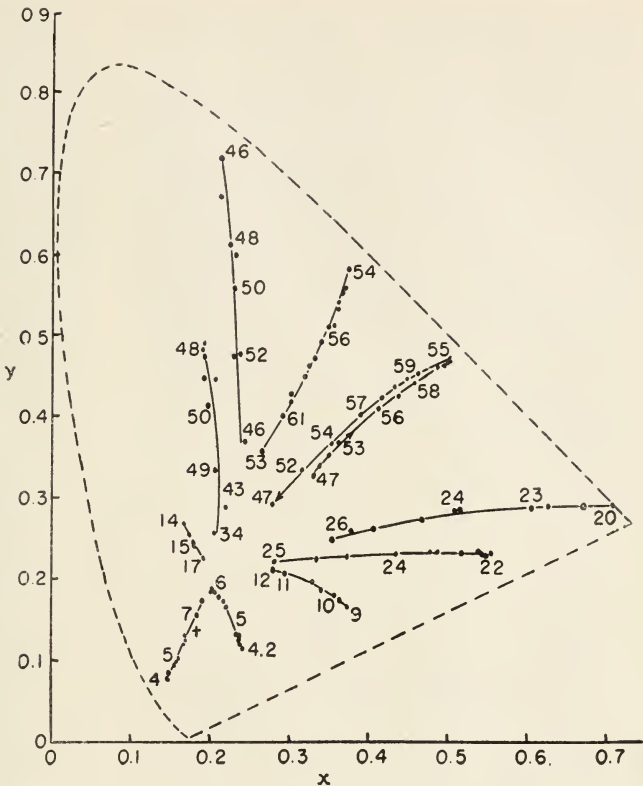


Fig. 5

Loci of constant hue for green surround (shown by cross).

effects of simultaneous contrast when the general surround is green.

The preceding results were obtained with a test field subtending  $12^\circ$ . Fig. 6 shows results obtained with a test field subtending  $2^\circ$ , with a surround only slightly greenish compared to daylight. In this case, hues particularly easy to remember were chosen. Thus, the yellow was neither greenish nor reddish, and the purple was not predominantly bluish nor reddish. The innermost extremity of each curve again represents

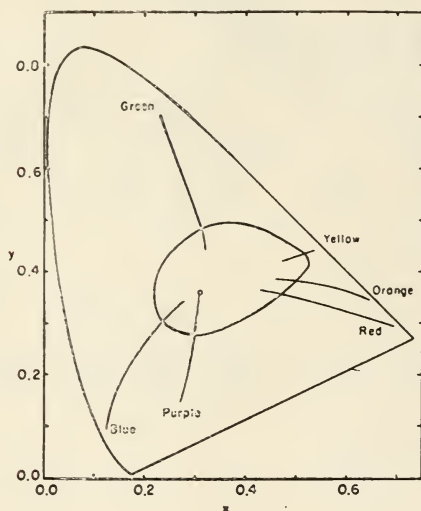


Fig. 6

*Loci of named hues and of constant saturation in a  $2^\circ$  field, surrounded by daylight (shown by circle).*

the colour which appeared white in one semicircle, when the saturated colour represented by the outer extremity was in the adjacent semicircle.

The oval curve represents a series of colours of various hues but equal saturation, as judged by comparing neighbouring hues in the  $2^\circ$  field.<sup>6</sup> These comparisons were begun at yellow and progressed through orange, red, purple, blue and green, back to yellow. The sequence was then reversed, with results which verified quite closely the results of the first sequence. The circle near the centre represents the colour of the surround, which at all times appeared as an acceptable white.

Fig. 7 shows similar results for the same hues, and for constant saturation, with a surround nearly matching the colour of a 3200 K black body light source. The results for the two different colours of surround are compared in Fig. 8. The saturations corresponding to the constant-saturation ovals were not necessarily equal in the two surrounds.

Very few data of the kind shown here have been published. Bouma and Kruijthof<sup>7</sup> identified sets of colours which

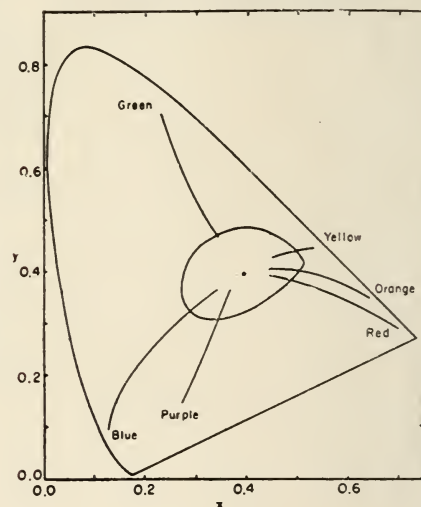


Fig. 7

*Loci of named hues and of constant saturation in a  $2^\circ$  field, surrounded by incandescent-tungsten-quality light (shown by circle).*

appeared to have the same hues in several surrounds. They did not determine constant-hue loci, estimate the saturations of their colours, or evaluate the effects of simultaneous contrast. As a matter of fact, they assumed the constant-hue loci to be straight lines radiating from the point representing the surround, and they drew far-reaching conclusions from extrapolations based on that assumption.

Newhall, Nickerson and Judd<sup>8</sup> published curves of constant hue and saturation derived from observations of Munsell paper samples in daylight. Helson and Grove<sup>9</sup> studied the changes of hue, lightness and saturation of surface colours in



passing from daylight to incandescent-tungsten-lamp light. The meaning of their results is obscured by the fact that the colour stimuli, adaptations and perceptions were all permitted to change simultaneously. To determine unambiguously the effects of adaptation on colour sensation, it seems advisable either to keep the stimuli unchanged and report the hue and saturation resulting for different adaptations, or to readjust the stimulus for each adaptation so as to keep the hue and saturation unchanged, as was done by Hunt,<sup>10</sup> and as was done for hue, although not for saturation, in the present investigation.

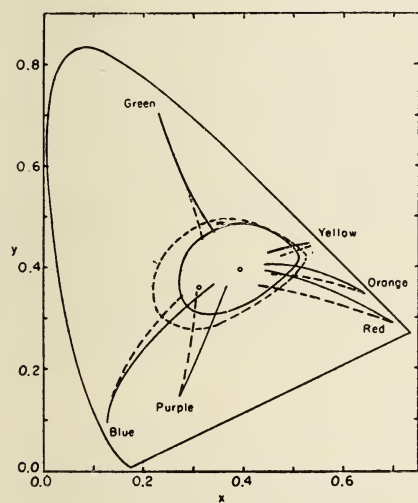


Fig. 8

Comparison of loci of same hues, and of constant but not necessarily equal saturations, in 2° field surrounded by daylight (broken-line curves) and tungsten light (solid-line curves).

Within the past year, Richter<sup>11</sup> has published curves purporting to represent various degrees of saturation. These were interpolated and extrapolated from the curve shown by the broken line in Fig. 9. The solid curve is that shown in Fig. 6, for adaptation to daylight. Unfortunately, Richter did not control the adaptation of his observer, nor determine what stimulus appeared white under his conditions of observation. Since his judgments of equal saturation were made with a dark surround, it might be presumed that white is repre-

sented by the point marked with a question mark. This guess is based on determinations of white in dark surrounds by Priest,<sup>12</sup> Helson and Michels,<sup>13</sup> Hurvich and Jameson,<sup>14</sup> and MacAdam.<sup>5</sup> However, the effects of simultaneous contrast, indicated by Fig. 2, must have resulted in a different criterion of white and a different basis for saturation for each hue. The interpolation of curves for other degrees of saturation in Richter's method was based on the implicit assumptions that white paper would appear white when seen through the instrument used to determine the curve in Fig. 9, and that the effects of simultaneous contrast

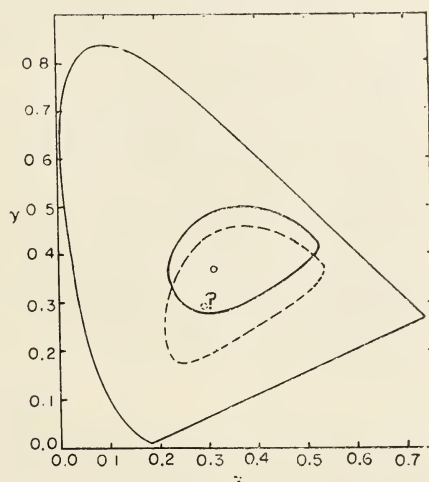


Fig. 9

Comparison of Richter's locus of constant saturation in dark surround with locus of constant saturation in daylight surround (solid-line curve).

would not disturb the criterion for white. Since he did not use any surround to control adaptation, these assumptions do not seem to be admissible. Therefore, the curves Richter interpolated and extrapolated are of doubtful significance.

In conclusion, it can be stated that the colour of the surround influences, to an important extent, the hues and saturations perceived in a picture. The results shown in Figs. 2 to 8 are intended as a guide in estimating the kind and degree of effects to be expected with various surrounds. These results also indicate that engineers can no longer be content with looking at

colours. The effects of adaptation are too great to be ignored, and are too complicated for guesswork, or for reasoning based

on casual impressions. In order to deal effectively with colour, it is necessary to measure colour.

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## THE COUNCIL

*Summary of the meeting held on Wednesday, December 5, 1951, at 117, Piccadilly, W. 1.*

**Present:** Mr. B. Honri (*Vice-President*) in the Chair, and Messrs. H. S. Hind (*Deputy Vice-President*), R. J. T. Brown (*Hon. Secretary*), N. Leever (*Hon. Treasurer*), D. F. Cantlay, F. S. Hawkins, E. Oram, R. E. Pulman and S. A. Stevens.

**In attendance:** Miss J. Poynton (*Secretary*).

**Apologies for Absence.**—Apologies for absence were received from the President, the Past President and Messrs. F. G. Gunn and T. W. Howard.

**Society Dinner.**—A Dinner will take place at Grosvenor House in April of this year.

**Projectionists' Training Scheme.**—A meeting of the Training Scheme Committee is being arranged.

**Tele-Kine Group.**—The full complement of students for the course on Television in the Kinema has been enrolled. The course will take place at E.L.M.A., 2 Savoy Hill, W.C.2.

## COMMITTEE REPORTS

**Publications Committee.**—The Committee is willing to consider the publication of submitted

papers. It is hoped that it will be possible to publish the lectures in the course on Television in the Kinema.—*Report received and adopted.*

**Library Committee.**—A scheme is to be submitted to Council which provides a basis for lending books to a large group of prospective Student Members.—*Report received and adopted.*

**16 mm. Film Division.**—It is hoped that Part I of the reports of the Investigation Technical Subcommittees will be complete by April of this year.

The South African bureau for the classification of projectors is to be examined.—*Report received and adopted.*

**Theatre Division.**—Efforts are being made to complete the last part of the lecture programme for this Session. The Chairman has delivered a paper to the Manchester Section, which was well received.—*Report received and adopted.*

**Film Production Division.**—The illness of the Chairman has delayed the Divisional meeting, but arrangements for all meetings have now been finalised.—*Report received and adopted.*

The proceedings then terminated.



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## THEATRE DIVISION

IT is appropriate that the last Divisional Editorial should be devoted to the Theatre Division, because its members are predominately concerned with the end product of the film industry. Among their number will be found representatives of cinemas throughout the country, besides leading technicians, engineers and manufacturers of cinematograph equipment.

This wide range of interest makes the Division a very active one, and its regular meetings in London and in the provinces continue to grow in popularity due to the high quality of the papers, and the friendly "get togethers" which usually precede and follow them.

The Division pays particular attention to the Society's educational role, and at present a course of lectures is being given dealing with television in the cinema. In view of the demands it is necessary that

this course be repeated in provincial centres.

Last year the Division accepted what may prove to be the Society's greatest responsibility. It undertook, at the request of the C.E.A. and the N.A.T.K.E., the preparation of the training syllabus for apprentice projectionists.

Recently the rules of membership were adapted in order to admit chief projectionists to the grade of Corporate Membership. This was a step advocated by many in recognition of the responsibilities of those forming the last link in the chain from production to patron. It is hoped that Chiefs will take advantage of the opportunity, and recognise the Division's activities as being a means of widening outlook from what the trade terms "the box" and the legislation "the enclosure."

H. LAMBERT.

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# TECHNICAL ASPECTS OF "THE TALES OF HOFFMAN"

Christopher Challis

*Read to a meeting of the Film Production Division on November 21, 1951.*

THE earliest beginnings of "The Tales of Hoffman" was a meeting, attended by the producers, Michael Powell and Emeric Pressburger, the designer, Hein Heckroth, the choreographer, Frederick Ashton, the ballerina, Moria Shearer, and the author. A special recording of the music of the opera, a piano solo by Sir Thomas Beecham, was played. Hein Heckroth, in the form of sketches, interpreted visually the opera as he saw it. Ideas were developed in relation to a modest budget in which the main characteristic was that fantasy, imagination, colour and atmosphere took the place of plaster and wood.

Hein Heckroth is a painter of the modern school, in which the medium is colour, light and air. If the mood of his designs was to be retained this medium would have to be used when translating them on the film.

A means had to be found of achieving the desired effects on the studio floor without recourse to special effects after shooting. Takes were seen daily in order to judge the visual aspect in relation to the designs and the music. Too much use can be made of special effects and thus there is a danger of technicians becoming too specialised. The approach was greatly influenced by Hein Heckroth's theatrical background.

## The Prologue

In the prologue of the Tales it was desired to indicate that a performance of the ballet "The Enchanted Dragonfly" was being held in the Opera House of the City of Nürnberg. A simple design was used. Cut outs of weather vanes against a night sky backing, the façade of a theatre, the cloak-room, and, finally, craning into a programme on the counter. There was no set and there were no artists, yet the desired effect was complete.

The story of the ballet which followed was that of a female dragonfly. She emerged from a pond, the male jumped down from

the branch of a tree, and they danced together on the lilies in the moonlight. After mating she killed him, and as he sank she climbed grotesque branches to the moon.

The set was simple, a painted floor and a backdrop being used. The shots of the female dragonfly rising to the surface of the pond and ascending to the moon were both achieved with gauzes. In ascending to the moon five separate planes of gauze were used, with leaves painted on them to hide the ramp on which she danced. Each layer cut the light by about ten per cent., so it was quite a problem to get sufficient illumination on the backing. In rising to the surface of the pond the dragonfly danced at the top of a 20-foot tower placed in front of a blue-green backing. The tower was painted and lit to match the backing, and in front of the dancer was lowered a gauze, stretched on a frame, on which were painted under-water effects and the surface of the pond with lilies on it. As the surface of the pond appeared in front of her, the hard edge of the effects spotlight was panned down her body to give the impression of the breaking of the pond's surface and the emergence into the moonlight.

## Act I.—The Tale of Olympia

Each act of the opera was basically a different colour, in order that the diversity of the loves of Hoffman in character and environment be stressed.

Act I takes place in a puppet maker's house in Paris. It was to be light and airy in character. The sets chiefly consisted of draped yellow gauze and lighting, by different effects, both the back and front. On all the large ballet sets the Mole Richardson 350 amp. effects spotlight was used, as it was felt that it added feeling to the story and helped focus attention where it was required.

Olympia's bedroom consisted of three concentric rings of draped yellow gauze, beyond which was painted yellow candlelight and chandeliers on a cyclorama, also yellow.





Fig. 1

*A still from the Prologue, which shows how the effective use of gauze created illusion.*

Cellophane cut-outs, painted to resemble chandeliers, were hung against the curtains to increase the effect of light and atmosphere. The main shot was a 360° pan of Hoffman entering the bedroom and walking around the inner circle of the room, which was about 30 feet in diameter. As he walked, the lights and chandeliers were lit, one by one, by means of remote control dimmer shutters. During the lighting of this set the studio roof began to sag, and the lamps from the inner circle of spots had to be moved. The action was finally lit from the floor, and entailed tracking the lamps in and out of the gauze curtains to miss the camera as it panned.

The ballroom set also consisted of yellow gauze. This was hung in three planes against a yellow backing, painted and with the cellophane chandelier effects. This extensive use of gauze proved most interesting as it offered a new field of experiment. Numerous effects and textures are obtainable with the same piece of set by varying the angle of the light from the front to the back.

In one sequence, Olympia and Hoffman are seated on a couch in the yellow ballroom. On the gauze behind them was painted the shape of a harp, the centrepiece of the ballroom set. As Hoffman sang, the camera

tracked back and the background slowly changed. The harp was transformed into a swan and the yellow light dimmed. A lake appeared with a moon shining down on the two artistes. Hoffman reached down to touch Olympia, and in a moment the spell was broken and the scene reverted to the ballroom. This effect again was obtained with gauzes. Immediately behind the couch was a yellow gauze on which was painted the harp design. Ten feet behind this was a black gauze with the outline of a swan painted in white. This was exactly in line with the harp on the front gauze from the position of the cameras. There was also a backing on which was the swan, lake and moon. Again, the swan was aligned with the harp and the white outline of the middle gauze. Each plane was lit independently, and by using remote control dimmer shutters on all lamps the changing effects were controlled to coincide with the music cues on the play-back.

The first change was a slow transition, lasting about thirty seconds. The changeback to the ballroom, when Hoffman touched Olympia, was instantaneous. A certain amount of difficulty was encountered in this type of shot, when the heat generated by the lamps caused the dimmer shutters to stick,



Fig. 2

*A design for Act I,  
by Hein Heckroth.*

It was found that the arcs could only be lit up and burned for the minimum time.

The giant staircase, down which Hoffman and Olympia danced in the sequence where she runs out of control, was painted on the studio floor and shot from the gantry. It was a typical example of what can be achieved, in colour, for very little cost. If the scene is analysed, it will be seen that it

bears little resemblance to a real staircase. It was not meant to do so, yet it is accepted at once by the audience.

To achieve the maximum effect for the destruction of the doll by Coppélius and Spalanzani, the colour theme of the act was changed. In the sequence where Olympia was dismembered, a black velvet backing was utilised. A series of black velvet bags were

Fig. 3

*The same design transformed  
into the medium of the screen.*





made to cover the head, arms and legs. A shot was taken of Spalanzani pulling Olympia's arm, the camera was cut, and the arm was covered with one of the velvet bags. The action was then duplicated exactly as before. By cutting at the right moment between the two takes it appeared as though the arm had been pulled off. This was repeated for each part of the body. The doll was gradually enveloped in more and more black velvet until only one kicking leg was visible. This effect was illogical and illusionary, but very effective.

In front of the final scene, where there is a

an instant by the utilisation of a dual lighting system and dimmer shutters. This is one of the most effective shots in the picture.

The last scene in Act I was a close-up of Olympia's head, with the eyes still flickering. From the rear of the head a spring appeared. The sound of the spring became the first note of the Barcarole, the introductory music to Act II, and its shape turned into a spiral reflection in the water of a canal. To achieve this, a piece of floor was tilted at an angle in order to allow Miss Shearer to stand behind, with her head visible. Behind her was fitted a device holding the spring. She blinked her



Fig. 4

*The Giant Staircase, which was painted on the studio floor and shot from the gantry.*

fight over the doll's head, a gauze painted with impressionistic forms suggesting a dismembered mechanical doll was placed between the camera and the artiste.

Mention must be made of the small sequence in which Coppélius takes Spalanzani's cheque to the bank, only to find that it is dishonoured. The set, in this case, consisted of a small backing on which were painted large inkstains. The bank clerk sat behind a small window covered with ink spots, and the scene was shot through a gauze painted with more ink stains. When the cheque was passed back to Coppélius by the clerk, the lighting was changed to green for

eyes in time with the music and the spring was set in motion. The reflection was then lined up through the camera with the moving spring. In the final picture a lap dissolve was used.

#### **Act II.—The Tale of Giulietta**

The second act is the tale of a Venetian courtesan who stole men's reflections and so gained their souls. It was a complete contrast to Act I. The impression of a decadent, lustful and romantic city of canals, palaces, gondolas and slime had to be conveyed. This had to be created in a very realistic manner.

A long trough was built and filled with



Fig. 5

An impressionistic design  
by Hein Heckroth of Act II.

water. The bottom was painted with suggestions of palaces and bridges. Paintings on glass of palaces and narrow streets, lit from both front and rear to give luminosity to windows and lamps, were then reflected in the water. Coloured oil pigment on the surface of the water formed into strange designs as the camera tracked the length of the trough,

each reflection being wiped out by rippling the surface of the water on a given musical cue.

As Giulietta leaned over the side of a gondola her reflection was seen in the water, and appeared to sing a duet with her. A close-up of her with the background moving in the opposite direction to the main scene and then



Fig. 6

A still from Act II, which  
shows how the atmosphere  
of decadence and lust was  
conveyed.



fading in with the moving water effect shot in the tank overprinted on it, was used to create this illusion.

Dappertute, Giulietta's evil companion, had to appear and disappear during a sequence as if by magic. This was achieved by first shooting the scene with both artistes up to the point where Dappertute had to vanish, then, with the camera still running, he stepped out of the shot, whilst Giulietta remained still. On a given cue a shower of gold-dust was dropped where he had been sitting, and she resumed the action. When the two shots were lap-dissolved together, Dappertute appeared to vanish in a cloud of

another problem in Act II. For this, the frame of a mirror was built, and behind it an exact replica of the set in front. This artificial reflection was painted with a slight blue tint to aid the deception. When Hoffman lost his reflection, it was decided to use a split screen shot. The right-hand half of the screen, with Hoffman and Giulietta in front of the mirror, was first photographed. Then the left-hand portion was exposed with them behind the mirror frame, i.e., they became their own reflections. They performed all the movements they had carried out in front of the mirror in the opposite direction and in time with the music. At the moment when



Fig. 7

*A design for Act III, showing Antonia approaching the vision of her mother.*

gold-dust. On this type of shot it was a great advantage to be working with ballet dancers who were able to pick up exact musical cues from the play-back, and who could, to all intents and purposes, remain still for minutes at a time.

The water effects on the long shots of the gondola gliding through the canals was achieved with a gauze stretched away from the camera at an angle of approximately 35°. On the gauze were painted water effects and glitter. This was to be an artistic conception, in no way resembling reality.

The mirror in which Giulietta's lovers lost their reflection whilst hers remained was

Hoffman's reflection disappeared Giulietta held still, while he slipped off the set. She then continued the scene and once again the two portions were lap dissolved together so that the reflection faded in her arms, while in the foreground they both remained.

### Act III — The Tale of Antonia

In the centre of the silent stage at Shepperton Studios stood a circular room about fifty feet in diameter, the walls of which consisted of a double row of colonnades open all the way round. To the south was the sea, to the north the ruins of an ancient Grecian amphitheatre, and to the east and west tall

cypress trees and sky. The stage was encircled with a huge cyclorama on which all these background effects were painted. The trees and rocks were cut-outs, and the sea was painted on to a sloping ramp to give a hard horizon line against the sky. This ramp was stopped fifteen feet short of the backing in order to allow room for lamps, which were to light the bottom of the backing. It also enabled the sky to be lit independently of the sea. The amphitheatre consisted of a sloping ramp on which were arranged the ruined columns and other debris, the rest of the effect being painted on the cyclorama.

The preparation of this set for lighting from the point of view of rigging and wiring was an operation of some magnitude, for in order to carry the load the arcs had to be in series. The area of backing involved was enormous and there was no possibility of using Duars or other types of flood lamp for illumination. Type 170 high intensity arc lamps and "Brutes" were used in conjunction with a No. 1 frost gelatine filter to destroy the hard-edged circle of light thrown by the spots. Several alternatives were tried before it was decided to use this method. In one instance the lamps were used without condensers, but this was found to result in too great a loss of light. The old ideas of using translucent or tracing paper again cut down the light and also had the disadvantage of turning the lamps red. More recently fibreglass diffusers have been used for the same purpose, and have been an improvement on the frosted gelatine. Fibreglass filters are now available in this country. They do not affect the colour of the light source in any way and are impervious to heat, which is, of course, a great advantage.

Over the entire area of the cyclorama light changes from day to night during the course of a scene had to be prepared. This once again involved the use of remote control dimmer shutters. The complete backing and set for a master shot, which during the course of the action panned the 360° around the stage, had to be lit.

The story of the act tells how Hoffman falls in love with Antonia. Her mother has already died of consumption and Crespel

grief-stricken at his wife's death. Crespel keeps his daughter in seclusion on an island in the Greek Archipelago and has forbidden her to aggravate her weakness by singing. He has also forbidden his deaf servant to admit either Hoffman or the quack Dr. Miracle, who killed his wife. Franz misunderstands, and in turn shows them in. Hoffman obtains her promise not to sing again. Dr. Miracle persuades her it is her mother's wish that she should disobey. She does so and dies.

In one of the scenes Antonia ran towards a vision of her mother, which bridged the theatre, taking shape around her. As she approached the vision it disappeared, only to reappear in woods garbed in spring, summer, autumn and winter. Antonia loses her each time. As she ran grotesque hands appeared to applaud her from the bottom of the picture. These hands in turn changed to flames. When she reached her top note, which kills her, the background slowly changed back to the house on the island.

It was difficult to arrange this shot; it was found that the sequence involved about 40 opticals. Three or four only were possible, so most of the effects had to be achieved in the camera, i.e., fades, dissolves, split-screen shots, double exposures, etc. For the woodland scenes, foreground and background gauzes, painted with trees and leaves, were used. The soft-edged split screen process was used for the disappearance of Antonia's mother. The hand and flames were double exposed on to the original by carefully noting footages and working closely to musical cues.

For the scene of the return to the island house, Dr. Miracle was shot large in the foreground, and behind him a semi-circle of candle footlights against the darkness, to suggest the stage of a theatre. As Antonia reached her top note the candles gutted and went out and smoke rose from them. This was done by lighting the set beyond the footlights entirely through dimmer shutters, remotely controlled. The shutters were slowly opened as the camera tracked forward through the rising candle smoke.

*During the course of the paper, sequences from the Prologue, and the three acts, of the opera were projected.*



# CHEMICAL SHORTAGES AND THE EFFICIENT USE OF PROCESSING SOLUTIONS

*Summary of a Symposium presented to a Joint Meeting of the British Kinematograph Society and the Royal Photographic Society on October 3, 1951.*

## I.—A SURVEY OF SULPHUR RESOURCES

D. H. O. John, B.Sc., A.R.I.C.\*

**S**ULPHUR and sulphur compounds are of the greatest importance in the manufacture of photographic chemicals, and our recent shortages are due to the shortage of sulphur.

### Elementary sulphur

Italy and Sicily supplied the sulphur requirements of almost the whole world until the early years of this century, when large-scale production of sulphur commenced in the United States.

The total world production of elementary sulphur changed from 90% Italian produced sulphur in 1905 to 90% American produced in 1920. This rapid rise in American production of sulphur was largely due to the success of prolonged efforts to make the Frasch system of steam extraction of sulphur commercially workable. This made possible the extraction of the huge deposits in Louisiana and Texas which were previously unworkable.

Although the U.S.A. no longer retains a monopoly of supplies of sulphur, it produced nearly five million tons last year by this method.

### Sulphur compounds

The most important sulphur compound mined is iron pyrites, a sulphide of iron containing about 45% sulphur, which is found in many countries, particularly Spain, Japan and Norway.

Two other important sources of sulphur compounds are spent oxide, a waste-product of the coal-gas industry, obtained by scrubbing the impurities out of crude coal-gas, and anhydrite (calcium sulphate).

The uses made of these materials in this country show that our internal production is less than one-quarter of our needs, our dependence upon American sulphur increasing in the past twelve years from 23% to 62% of our total consumption.

### Production of other chemicals

Of the various sulphur-containing products the most important is sulphuric acid. So essential has it become that it is difficult to find an industry of any magnitude in which it does not play an important part. During the past fifteen years there has been a marked trend in this country towards the use of elementary sulphur from America for the manufacture of sulphuric acid in place of pyrites from Spain. The embargo on American sulphur supplies, which was threatened a year ago, was therefore of the greatest significance to our sulphuric acid industry.

Sulphuric acid is responsible for about 85% of our total consumption of sulphur and sulphur compounds, and the quantities of sulphur used for chemicals in which the photographer is more directly interested (sulphites, bisulphites and thiosulphates) seem trivial by comparison. However, indirectly sulphuric acid is important in the manufacture of photographic chemicals.

### Synthesis of Metol and Hydroquinone

Since metol is the sulphate of an organic base, sulphuric acid is required in the last stage of its synthesis. It is, however, less obvious that this same acid is required at every stage but one in the synthesis (Fig. 1). It is either used as such, or some product made with its aid is used (dimethyl sulphate or hydrochloric acid).

\* Research Laboratories, May & Baker, Ltd.

Metol is not an isolated example. For hydroquinone the importance of sulphuric acid is even more impressive (Fig. 2), the acid being required at every stage in the synthesis, either directly or indirectly.

These two examples illustrate the importance of sulphuric acid in the production of the most familiar developing agents; other photographic chemicals, such as sodium sulphite, potassium metabisulphite and sodium thiosulphate are obviously dependent upon

- (i) Attempts were at once made to lessen the stringency of the reductions in American exports which have met with some success.
- (ii) Alternatives to sulphuric acid have been sought and considerable economies are being made. The largest use of sulphuric acid is in the preparation of superphosphate fertilisers; an efficient soluble phosphate has been produced by using nitric acid instead

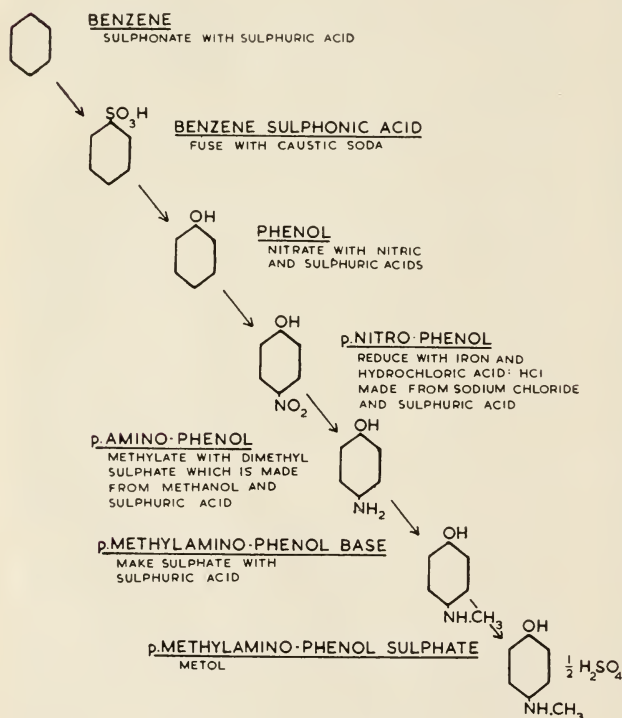


Fig. 1. Synthesis of metol.

sulphur supplies for their existence.

### Future outlook

Adequate supplies of sulphur and sulphur-containing compounds are therefore essential for many of the common photographic chemicals and hence for the practice of photography as we know it. The reduction in the quantity of American sulphur available to us must have important effects upon us all and below is a brief summary of the necessary steps to alleviate the shortage:

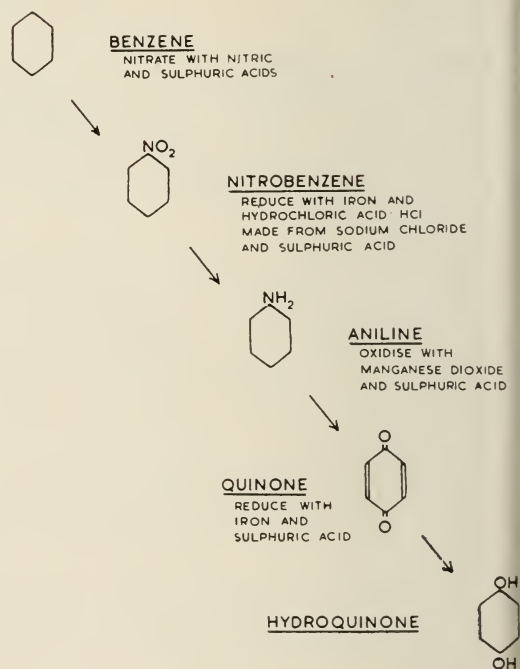


Fig. 2. Synthesis of hydroquinone.

of sulphuric. This discovery may have an important bearing upon our future acid consumption.

- (iii) Economies have been made by using in one process the spent acid from another, either in the same factory or in a neighbouring one. The saving in each instance is possibly small, but the total represents a worth-while contribution to the economy campaign.
- (iv) The use of American sulphur in place

of iron pyrites has had to be reversed. This was not easy, since pyrites burners are more difficult and more expensive to erect, but some progress is now being made.

- (v) Our neglected anhydrite resources are now being used. Production of sulphuric acid from anhydrite is generally uneconomic when a cheap source of pure sulphur is obtainable, but nowadays it becomes a practical proposition. For some years moderate quantities of sulphuric acid have been made from anhydrite; there are now eighteen new factories (or extensions to factories) being erected in this country for sulphuric acid manufacture, using either pyrites or anhydrite, and many of them will shortly be in production.

- (vi) There has been a world-wide search for new sources of sulphur. Many finds have been made, of varying quality, perhaps the most important being the deposit in the Mississippi River Delta, where a plant to produce half a million tons of sulphur a year is planned.

### Conclusion

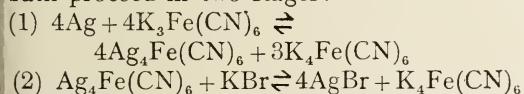
Although the present shortage of sulphur, sulphur compounds, and photographic chemicals is having a serious effect on photographic practice, the effect is not likely to be permanent. There is hope that by 1953 the shortages should cease. In the meantime, careful economy in the use of photographic chemicals is essential and it is the purpose of the later papers in this Symposium to indicate ways in which this economy can be effected.

## II.—THE REGENERATION OF FERRICYANIDE-BROMIDE BLEACH

F. E. Flannery, A.R.I.C.\*

**A** SOLUTION of potassium ferricyanide and potassium bromide is often used to convert silver to silver bromide prior to fixation in processing colour film.

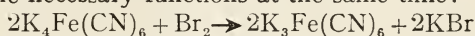
The reactions taking place in the bleach bath proceed in two stages:



The first of these reactions is the slower and controls the rate of bleaching. In practice it is necessary to use a solution in which the initial bromide concentration is almost half that of the ferricyanide. For example, if a bleach contains 10 per cent. ferricyanide and 4 per cent. bromide, then 16 grammes of silver per litre will double the bleach time, while if the bromide concentration is halved, the same quantity of silver will increase the bleach time by a factor of five. If the tolerance on a processing machine allows the bleach time to increase by 100 per cent., then at least half the chemicals are wasted.

To regenerate a used bleach bath it is

necessary to convert the ferrocyanide to ferricyanide and to restore the bromide concentration. The addition of liquid bromine is a method which involves fewer controlled additions than other methods and causes least dilution of the bath. Bromine performs both the necessary functions at the same time:



The ferrocyanide concentration in the used bath is determined by potentiometric titration against ceric sulphate solution and the required bromine addition is calculated on the basis of 0.22 gramme or 0.07 cc. of bromine per gramme ferrocyanide. In order to avoid adding an excess of bromine, a bath is regenerated to leave 1 gramme ferrocyanide per litre. Potassium ferricyanide is unstable in acid solution so precautions must be taken against contamination by an acid stop bath or by hypo. If the bath becomes acid it will, on regeneration, precipitate prussian blue, staining the film. To avoid this, buffer the bleach to a pH of approximately 6 with sodium phosphate and sodium bisulphate,

\* Research Laboratories, Ilford Limited,



Bromine fumes very freely in air and will cause severe skin burns, so all operations should be conducted in a fume chamber or a strong draught, and protective clothing should be worn.

The required quantity of bromine is dissolved in about four times its volume of methyl alcohol and run into the bleach by a long tube dipping well below the surface, stirring to ensure adequate mixing. The salt concentration of the bath is checked with a hydrometer and dry chemicals added to compensate for carry over.

Five feet of 35 mm. film of average coating weight gives approximately 1 gm. of ferrocyanide. With the recommended bath of 10 per cent. ferricyanide and 4 per cent. potassium bromide the concentration of ferrocyanide will have reached 3 per cent. when the bleach time has increased by 50 per cent. and this is probably as much as could be tolerated in practice.

The author acknowledges the work in this field of J. E. Bates and I. V. Runyan<sup>1</sup> and of A. H. Brunner, P. B. Means and R. H. Zappert.<sup>2</sup>

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2. Analysis of Developers and Bleach for Ansco Color Film. *Ibid.*, 53, 25-35, 1949.

## III.—CONTINUOUS FILM PROCESSING

F. P. Gloyns, A.R.C.S., M.Sc., Ph.D., F.R.I.C., F.R.P.S.

**W**HEN large amounts of photographic material, of any type, must be processed to yield reproducible results it is necessary to make use of solutions of constant activity. Such solutions are continuously replenished in such a way that their chemical composition remains constant, the changes which are produced in the solution by the action of the photographic material being counteracted by the composition of the replenisher added. Success in any attempt to hold the photographic activity of a developer constant comes from a proper understanding of the chemical reactions taking place in the developer allied to reliable methods of estimating the important chemical compounds present.

In this paper reference will be made only to developing solutions as they present the most difficult problems and as fixing solutions are to be dealt with separately.

### Composition of the developing solution

As the metol-hydroquinone developer is used for the great bulk of black and white processing, reference will be made to this developer only.

The constituents which are of major importance in the present consideration are:

(a) The developing agents. (b) The preservative. (c) The alkali, and (d) The restrainer.

The developing agents are metol and hydroquinone, whose function is to reduce to metallic silver the silver halide in the emulsion which has been affected by light. They are generally employed together as the results with the combination are superior to those obtained with either separately. Conventionally developing solutions are formulated with more hydroquinone than metol, but this need not be so, particularly when continuous replenishment is used.

The preservative is almost invariably sodium sulphite and it protects the developing agents from being rapidly destroyed by the oxygen of the air; it also takes part in the reactions of development.

The alkali is present to provide a suitable medium for the action of the developing agents, which are powerfully affected in their activity by the alkalinity (or pH) of the solution. The alkalis commonly used are sodium hydroxide, carbonate or borate. The chemical nature of the alkali is of little importance; it is the pH of the solution which



governs its activity. There appears to be some mystery to many photographers about this quantity pH. From their point of view it can be considered simply as a scale of acidity or alkalinity. The scale runs from 0 to 14; solutions having pH values between 0 and 7 are acidic and those with pH value from 7 to 14 are alkaline; the higher the pH the greater the alkalinity. If two solutions are prepared of equal pH produced by using quantities of different alkalis, then, secondary effects apart, their photographic developing activities will be equal.

The restrainer almost always consists of a soluble bromide. It has the effect of prolonging the time of development and of reducing the tendency to formation of chemical fog (development of unexposed grains).

Other chemical compounds are present in used developer but their photographic activity is generally small and for all practical purposes they may be neglected.

### Reactions in the developing solution

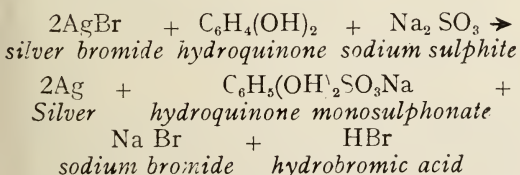
When an exposed photographic emulsion is placed in a developing solution two things happen simultaneously under practical conditions:

(A) The exposed silver bromide in the emulsion layer is converted to black metallic silver (the normal development reaction).

(B) The solution absorbs oxygen from the air.

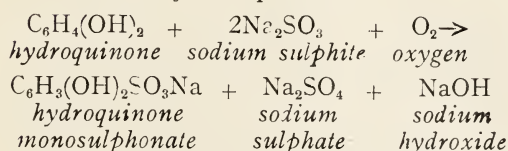
Let us consider each of these reactions separately.

(A) Using hydroquinone as an example of a developing agent the reaction of photographic development may be written



The significant facts to note from the equation above are that, when silver bromide is reduced to silver,

- (i) The developing agent is converted to a colourless soluble photographically inactive compound, so decreasing its concentration in the solution.
  - (ii) Soluble bromide is liberated which has a restraining action on the solution.
  - (iii) Acid is liberated which tends to reduce the pH of the solution so decreasing activity.
- (B) The absorption of oxygen by the solution may be represented:—



The significant facts to note from this equation are that by the oxidation of the solution

- (i) Developing agent is used up.
- (ii) Alkali (sodium hydroxide) is liberated, which tends to increase the pH and so increase solution activity.

Since under all practical conditions reactions (A) and (B) occur together we may summarise the changes brought about in the developing solution by use as:—

- (i) Consumption of developing agent and sulphite.
- (ii) Liberation of soluble bromide.
- (iii) Change of pH of solution (in most cases pH decreases but in special cases pH may increase).

### Composition of developer replenishers

No commercially practicable method is available for removing the soluble bromide from a developing solution. All that can be done is to throw away a part of the used developer and replace it by a bromide free developer, carefully balancing the amounts rejected and replaced so that the bromide content of the solution remains steady. It will be realised that once the permissible level of bromide in the solution has been decided then the rate of replenishment is thereby fixed, and can be calculated from a knowledge of the amount of bromide liberated per unit area of the emulsion in question. It will be noted that the volume of developer in use

has no direct effect on the rate of replenishment. Where photographic products are being processed continuously, developer is being continuously carried away on the processed material. This loss may remove sufficient developer to keep the total volume constant or it may be necessary to supplement it by rejecting additional quantities of developer.

Once the rate of replenishment is fixed the composition of the necessary replenisher follows. It will contain the same ingredients as the original solution but no bromide, the concentration of metol hydroquinone and sulphite being increased to replace the losses due to development. The relation between the pH of the developer solution and the pH of its replenisher will depend on the conditions under which the developer is used.

The rate of replenishment decreases as the permissible concentration of bromide in the solution increases. Therefore to economise in chemicals we fix as high a level of permissible bromide content as possible. In negative developers a low concentration of bromide is necessary and a very high rate of replenishment is essential. For this reason continuous replenishment of negative developers is rarely economically practicable unless some use can be found for the rejected developer.

For the correct functioning of a continuously replenished developing solution both sensitometric and chemical testing are necessary. Sensitometric tests check the correct functioning of the system and indicate any deviation without, however, giving any indication as to its cause. Reliable methods of chemical analysis are the key to success in

continuous replenishment, and it may be remarked here that methods of doubtful reliability (however expeditious) can give rise to considerable confusion. Methods which are known to be very reliable are given in the appendix at the end of this article.

In actual practice it is noticed that it is quite easy to attain a constant concentration of metol in a developer but it is less easy to keep the hydroquinone equally constant. Luckily, relatively large changes in hydroquinone concentration cause only slight variations in activity, although similar changes in metol content would cause large variations. The reason for this behaviour has been clarified by recent research. In a metol-hydroquinone developer, working at normal pH values, the bulk of the reduction of silver halide is brought about by metol, the hydroquinone being relatively inactive. The product of the development reaction is oxidised metol, which can react either with sodium sulphite to give inactive metol sulphonate or with hydroquinone to form metol and oxidised hydroquinone. The regenerated metol is available for reduction of further silver bromide and the oxidised hydroquinone reacts with sodium sulphite to yield inactive hydroquinone monosulphonate. The net effect of these reactions is that the concentration of metol remains fairly steady while the concentration of hydroquinone falls. In the replenisher the metol content will be little different from that in the solution while the hydroquinone content will be markedly greater than that in the solution. In view of the fact that the price of metol is much higher than that of hydroquinone this is a very happy circumstance.

#### IV.—A NEW COMMERCIAL DEVELOPING AGENT

J. D. Kendall, Ph.D., F.R.I.C.\*

**I**N 1940 it was shown at Ilford that 1-phenyl 3-pyrazolidone could be used in place of metol in compounded developers. A new method of synthesis has since been

developed from readily available intermediates, and economical manufacture on a commercial scale is now possible. This new developer is not merely a substitute to be

\* Rodenside Laboratory, Ilford Limited.

tolerated only as long as metol is in short supply, but possesses advantages over metol which make it a desirable product at all times.

1-Phenyl 3-pyrazolidone is a white crystalline compound which is tasteless and odourless. Unlike metol, it causes no staining of the skin; persons who are susceptible to metol poisoning can use pyrazolidone developers without any ill effects. The pyrazolidone, or "Phenidone,"<sup>†</sup> as we are calling it, is readily soluble both in dilute acids and alkalis, including carbonates, but its developing properties are shown only at high pH values, i.e. above pH 9. Like metol, its activity increases with increasing pH. When used alone, in a carbonate-sulphite solution, it is a very fast but extremely soft working developer.

When used in combination with hydro-

quinone, in an amount which is only a fraction of that of the metol employed in a corresponding M.Q. developer, Phenidone gives faster development with similar grain and fog, a higher degree of contrast, and a lower exhaustion rate than is obtained with the M.Q. developer. By adjustments of the developer formula it is possible with Phenidone-hydroquinone (or, for simplicity, P.Q.) developers to match very closely, but with less fog, the characteristics of standard M.Q. developers.

Some of these developers containing Phenidone have already been compounded and used in this country with highly satisfactory results.

In conclusion, it is pointed out that sulphur and sulphuric acid play a negligible part in the manufacture of Phenidone.

† Registered Trade Mark.

## V.—SILVER RECOVERY AND HYPO REGENERATION

C. J. Sharpe\*

THE continual rise in the prices of silver and hypo and the shortage of the latter chemical have emphasised the importance of silver recovery and hypo regeneration.

Silver can be recovered from used fixing baths by two methods: as a sludge or by electrolysis.

### Precipitation Methods

When silver is precipitated it is recovered in an impure state and a low price is obtained for it. In addition, the desilvered solution cannot be used again unless precautions are taken against staining.

As we are concerned with the efficient use of processing solutions which, in this case, can best be achieved by electrolysis, we will not describe the various precipitation methods, details of which were given in papers by Crabtree and Ross.<sup>1, 2</sup>

### Electrolytic Methods

The advantages of the electrolytic methods are: (a) the silver is recovered as relatively pure metal, and (b) the solution can be regenerated.

Too high a current causes sulphiding and if sulphiding occurs the fixing solution is discoloured and blackens the surface of the deposit, making plating of bright silver impossible. The tendency for sulphiding is much greater when the bath is poor in silver but less when the solution is slightly acid and contains sulphite.

A much higher current density can be used if the solution is agitated.

Electrolytic methods can be classed thus:

- (1) Electrolysis at high current density.
- (2) Electrolysis at low current density.
- (3) Galvanic units.

### Electrolysis at high current densities

The advantage of high currents is that

\* Research Laboratories, Kodak Ltd.



silver is recovered at a rapid rate with a small cathode area.

The conditions for good plating can be summarised as follows:<sup>3</sup>

- (1) High agitation.
- (2) Slight acidity (pH 4.5) and containing sulphite.
- (3) Continuous filtering.
- (4) Current density not more than 3 amp./sq. ft.

In the motion picture industry the equipment consists of several recovery cells, auxiliary to the fixing tanks, each cell fitted with stainless steel plates (cathode) and interspaced carbon sheets (anode). The solution is continuously pumped from the fixing tanks, through the recovery cells and back again, and is agitated in the cells by paddles or compressed air. The total cathode surface in each cell is about 70 sq. ft. and the current density is between 1 and 3 amp./sq. ft.

### Electrolysis at low current densities

The need for vigorous agitation can be avoided by using a low current density. To avoid sulphiding, even when the bath is poor in silver, the current density should be 0.01 to 0.02 amp./sq. ft.,<sup>4, 5</sup> with a potential difference of about 0.5 volt.

### Galvanic Units

If a base metal such as zinc and a more noble metal such as copper or stainless steel are connected together and immersed in a used fixing bath, zinc is dissolved and silver is deposited on the other metal. The current is relatively high, and silver sulphide is produced when the bath is poor in silver, causing blackening of the deposit.

Several ingenious devices are known to reduce the tendency to sulphide; the two metals may be partially insulated from each other to reduce the current or the metals may be connected by an external resistance to keep the current below a critical value.<sup>6</sup>

The galvanic unit is a convenient, though slow, method of recovering silver, but care is necessary if the unit is immersed in the fixing solution during processing.

### Regeneration of the Fixing Bath

A great advantage of electrolysis is that the fixing solution can be readily regenerated.

The fixing solution is diluted with rinse water during use, and its activity must be increased by adding further quantities of hypo, this procedure saving about two-thirds of the hypo.

The fixing rate is slowed down by accumulations of soluble bromide and iodide in the solution. It is normal, therefore, in the motion picture industry to "bleed" the fixing solution and to make up with concentrated fixing solution to keep the halide concentration low.

The acidity and sulphite concentration are reduced during use and must be replenished. This also applies to the alum concentration if a hardening bath is used.

In the motion picture industry it is usual to analyse the fixing solution, and from the results to calculate the strength of replenisher needed.

The method for replenishing an acid hardening fixing bath is as follows:

*Hypo.* The specific gravity of the unused solution is determined, and the determination is then repeated daily with the used solution, and sufficient hypo added to increase the specific gravity to its original value.

*Liquid Hardener.* The quantity of hardener to be added should bear the same ratio to the added hypo as in the original formula.

*Acidity.* Acidity is checked by adding a few drops of bromocresol green indicator to a small volume of the solution in a test tube. If the colour is blue, acetic acid should be added to the bulk until the test gives a green colour.

Where an acid hardening fixing powder is used, the powder is added until the specific gravity is increased to its original value. The acidity is then checked and acetic acid added if necessary.

For a simple acid fixing bath consisting of hypo and potassium or sodium metabisulphite, the acidity is determined by adding a few drops of bromocresol purple to a small volume of the fixing solution in a test tube.

If the colour of the test solution is purple, sufficient metabisulphite should be added to the bulk to produce a yellow colour when the test is repeated.

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## BOOK REVIEWS

*Books reviewed may be seen in the Society's Library*

*PRINCIPLES OF LIGHTING*, W. R. Stevens, B.Sc., M.I.E.E., F.I.E.S. (Member). Constable and Company, Ltd. 482 pages, 35s.

This is a text-book for lighting engineers of all types. It covers a field ranging from exposure for lighting and its measurement to light sources, studio lighting, airport lighting and natural lighting. Many of the chapters are of direct interest to film technicians, particularly the chapter in the first part of the book which deals with general aspects of the subject.

The first chapter concerns lighting and units for its measurement, giving a condensed account of these quantities and their inter-relations. It is followed by a valuable chapter on the process of seeing, which leads to a chapter on colour and photometry. A description of artificial light sources follows, then comes the design of fittings leading to their use in industry, the home, film studios, airports, etc.

The book has a very wide range and as a result no individual section is treated in great detail. It is, therefore, primarily a book for the general information of the specialist rather than a compendium for guiding him in his own particular field, and as such it contains many features of value to him. It has, for example, chapters on

decorative and flood lighting, road and interior lighting, and these contain many things of interest to people who have to light sets which represent these scenes and locations, where normal lighting is described in this book.

F. S. HAWKINS.

*NATIONAL FILM LIBRARY CATALOGUE: PART I—SILENT NEWS FILMS, 1895-1933.* The British Film Institute, London, 208 pages, 17s. 6d.

This is the first volume of the catalogue of the National Film Library collection of films, which has now vastly outgrown the single-volume method used in the 1936 and 1938 editions.

The present volume lists in chronological order with name and subject index more than seventeen hundred news items.

These are the bare facts. Only those well versed in the technicalities of our industry can envisage the careful preparation and enthusiasm which has made publication possible.

The work is, of course, mainly of direct interest to the student. If the British Film Institute shows an efficiency in its preservation technique equal to that shown in its cataloguing, the students of history in following epochs will be fortunate indeed.

R. J. T. BROWN.

## INDUSTRIAL FILM TECHNIQUE

*A Summary of papers read to a meeting of the 16mm. Film Division on October 10, 1951.*

### I.—INTERNAL RELATIONS

D. A. Gladwell\*

THE use of films by industry is ever increasing, for it is a far cry from early advertising shorts, used in the silent film programme, to present-day technique. The film to-day does an important job, both internally and externally, for the company or industry which sponsors it.

Internal use is by far the more recent of the two purposes. It was a long time before the majority of industrialists realised that a powerful, though expensive, advertising medium could be used within their factories and organisations for educating, instructing and creating good relations amongst employees.

In the past, many films must have been made without due regard being given to the possibility of their ever being screened. Of course, many instructional films have done, and still do, a very good job, but if due regard had been given to projection equipment and to accommodation facilities available, a far better product could have resulted.

To-day, when properly organised, the instructional film is well worth while. A large percentage of schools, colleges, and other training establishments, including many inside the works, have projection equipment and use films regularly to good effect. Excellent library services are available and are well used.

There are two types of film available for the furthering of good works relations, which are:

- (a) Those made by federations and trade organisations for the use of any firm in that industry ; and
- (b) those made by a firm or company for its own use.

I wish to speak from experience on the second type. An internal newsreel or kine-magazine is one phase in accomplishing one

of the main problems in industry ; the creation of a sense of common purpose and team spirit. The newsreel is the logical development of the house magazine technique of team building through information.

In a large company, the chairman, chief executives, salesmen and accountants, etc., are remote from the operatives in the factories, and *vice versa*. They rarely meet, and have no idea of each others' work, problems or personality. The newsreel helps to rectify this.

I am not qualified to consider the technical difficulties of editing a film once the photography is completed. In our case, there is a four weeks period in which the rushes are viewed, the order and make-up decided, titles composed, commentaries written, music chosen and the commentators assembled in the recording studio. It is our policy to have people from the floor of the shop, who have had personal experience with the subject on the screen, to act as commentators.

With the film finished, the task is now to ensure that every operative, employee and executive gets an opportunity of seeing it. To this end, a 16 mm. print is sent to each area for use with their own projector. In addition, a mobile kinema van tours every works in the Company.

Since the first issue of the magazine film I am connected with, production has been on 35 mm. stock, and the films shown on 16 mm. This has proved to be fortunate, for kinemas in the neighbourhood of the Company's works have been persuaded to include the newsreel in their programmes. Thus a far wider coverage, including many not connected with the works, has been obtained.

*The lecturer then projected a number of examples of the type of material selected for the magazine and concluded by showing the most recent issue in its entirety.*

\* Richard Thomas & Baldwin's, Ltd. (Publications and Films Department).



## II.—PUBLIC RELATIONS

G. de G. Barkas\*

IN the company I am connected with, we find that besides acting as distributors of petroleum products we must necessarily act also as consultants and educationalists in the correct use of petroleum products for industrial and other purposes. Many of the uses of petroleum products are so well known that they hardly need stating, but the extent to which petroleum enters into the fabric of our lives at every turn comes as a surprise to most people—even to many of us actually employed in the oil industry. In an industrialised community like ours it would be almost impossible to find a single person who does not buy and use petroleum products without necessarily realising it. Although films are costly to produce and distribute, we find that their use is justified for certain types of subject and audience.

I might classify our film audiences as follows:

- (a) *General Public*—with whom we do not concern ourselves to a great degree so far as films are concerned.
- (b) *Farming*—we attach a great importance to the agricultural market.
- (c) *Industry*—much the same applies to industry as to farming for it is in the ultimate interest of all that industrial machinery and processing should use our products to the best advantage.
- (d) *Motorists and Motor Cyclists*—these are a very large group of petroleum users with a keen interest on the sporting side.

Referring first to the farming community

which, scattered though it is, happens to be well organised for the distribution of films. In recent years the whole country has been covered by a network of farmers' discussion groups of which we have made full use. Our approach has been to exclude all sales plugging from our films and to make them an aid to commonsense thinking about the use of petroleum on the farm. It is recognised that the sound film is an unsuitable medium for teaching anything in detail and we have therefore taken topics which we consider of the widest practical importance, leaving the details to be taught by means of the instruction book. Films dealing with rust prevention, grass and grain drying, as well as the use and maintenance of the Diesel engine, have been made.

Industrial films for industrial audiences are made on similar lines, but while the potential audience in industry is vast, it is not so well organised for film distribution as the farming market. We have made films on such topics as the use of oil in industry, grease and fuel oil firing.

For the motoring community our object is to create goodwill and we have made and distributed films dealing with motor and motor cycle racing for which there is practically an unlimited demand by various motor and motor cycle clubs.

*Examples were shown of the way in which a programme of films and filmstrips together with lectures is used to present an educational programme to farmers and industry.*

*Finally, a film on racing and racing personalities was projected.*

\* Shell-Mex and B.P., Ltd.

## DISCUSSION

D. WARD: What projection methods are used to show the Shell film to the farming audience?

G. BARKAS: Up to a few months ago the projection was handled by three mobile units, complete with full 16 mm. projection gear, film strip projector, etc. With each of these units there was

a lecturer. This system broke down because there was no supply of new lecturers. The old lecturers became stale and tired. Since then we have relied for the most part upon film hire projection facilities.

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## THE COUNCIL

*Summary of the meeting held on Wednesday, January 2, 1952, at 117, Piccadilly, London, W. 1.*

**Present :** Mr. B. Honri (*Vice-President*) in the Chair, and Messrs. H. S. Hind (*Deputy Vice-President*), A. W. Watkins (*Past President*), R. J. T. Brown (*Hon. Secretary*), N. Leever (*Hon. Treasurer*), D. F. Cantlay, F. S. Hawkins, E. Oram, R. E. Pulman and S. A. Stevens.

**In attendance :** Miss J. Poynton (*Secretary*).

*Apologies for Absence.*—Apologies for absence were received from the President and Mr. F. G. Gunn.

*Society Dinner.*—The Society Dinner will take place at Grosvenor House, Park Lane, London, W.1, on Tuesday, April 8, 1952.

*Projectionists' Training Scheme.*—Members of the Training Scheme Committee are:

H.M.I. Mr. F. H. Dowden (representing Ministry of Education).

Mr. H. Lambert and Mr. V. Chapman (representing Cinematograph Exhibitors' Association of Great Britain and Ireland).

Mr. W. H. Kindleyside and Mr. M. McLoughlin (representing National Association of Theatrical and Kine Employees).

Mr. L. A. Blay, Mr. A. E. Ellis, Dr. F. S. Hawkins (*Chairman*), Mr. H. W. Preston, Mr. R. E. Pulman and Mr. J. A. Walters (representing the British Kinematograph Society).

*I.S.O. International Conference.*—The approach made to the Society to send one or more delegates to the International Standards Conference in New York is receiving prompt attention.

*Assistant Secretary.*—Miss S. M. Barlow has tendered her resignation to the Society, taking effect from January 31, 1952.

*Membership Committee.*—The following are elected:

Bhupender Singh (Student), Technical College, Blackpool.

John Cook-Abbott (Associate), George Humphries & Co., Ltd., 71-77, Whitefield Street, London, W.1.

Richard Waldegrave Baynton (Associate), Marks & Spencer, Ltd., 82, Baker Street, London, W.1.

Joseph Walter Frank Barber (Member), "The Studio," 7a, Colville Houses, London, W.11.

Roy Neville Wood (Associate), Christie Hospital and Holt Radium Institute, Manchester, 20.

The following transfer from Associateship to Membership is approved, subject to confirmation:

Miss Irene Dawn Cox, Plaza Cinema, St. Albans Road, Watford.

The resignations of five Members, seven Associates and three Students, and the death of two Members and one Associate are noted with regret.—*Report received and adopted.*

*Publications Committee.*—It is intended to publish an annual review illustrating technical progress made during the year. The first review will appear early in 1953.—*Report received and adopted.*

*Foreign Relations Committee.*—It is hoped in the not far distant future to be possible to allocate a page in the Journal each month to technical abstracts of an international character.—*Report received and adopted.*

*Film Production Division.*—The following Divisional representatives are appointed:

Papers Committee: Mr. T. W. Howard.

Membership Committee: Mr. A. Challinor.

Publications Committee: Mr. A. Challinor.

—*Report received and adopted.*

The proceedings then terminated.

# BRITISH KINEMATOGRAPHY

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MARCH, 1952

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## THE TELEKINEMA — 1952

IT is indeed good news that the industry as a whole is supporting and financing the scheme of the British Film Institute to utilise the Telekinema as a centre devoted to development of the art of the film. There has long been a need for a theatre where new and experimental work in films can be exhibited. Up to the present we in this country have lagged far behind New York, Paris and Rome.

It is natural that commercial organisations should limit their experiments in the technical and artistic fields of film production. Without encouragement and assistance this work could not continue at even its present level, with ultimate loss to the industry. The British Film Institute, in filling this need, is to be

commended for its far sighted policy which will undoubtedly add to the prestige of the industry.

It is also planned to use the Telekinema as a theatre for regular repertory programmes, so placing the cinema in its proper place alongside the other arts. What will probably be of most direct interest to our Society and other scientific organisations interested in films, is the existence of a suitable cinema which can be used on the occasion of an important convention or meeting.

Perhaps it will not be out of place to express a hope that some consideration will be given to finding another name more in keeping with the new functions of the Telekinema.

H.S.H.

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## A PROJECTOR - FAMILY PROGRAMME

Jan J Kotte\*

*Read to a meeting of the Theatre Division on December 9, 1951*

WE started our projector-family programme by designing a projector suitable for the biggest kinemas, keeping in mind that it must also be possible to omit in this design those special features which are not essential for medium-sized and small theatres. This means that the basic construction is the same for our three types of projectors: the FP.7 for the largest (Fig. 1), the FP.6 for the medium-sized and the FP.5 for the smaller kinemas (Fig. 2).

Some examples of the differences between the three types are given:

The lens holder of the FP.7 projector is suitable for lenses with the largest aperture, 1.4, and with a diameter of 104 mm. (about 4 ins.). For smaller theatres these very expensive lenses are not necessary and our FP.6 projector is equipped with a lens holder for lenses with an F-value of 1.6 and a diameter of 82.5 mm. (about  $3\frac{1}{4}$  ins.). The FP.5 projector has a lens holder for lenses with an F-value of 1.9 and a diameter of 62.5 mm. (about  $2\frac{1}{2}$  ins.).

These three types of lens holders are so fitted that they can be interchanged in a few minutes.

### Water-cooling System

The FP.7 and FP.6 projectors are equipped with an easily removable water-cooling system, which has been omitted in the FP.5. The system consists of a copper lining in the shutter housing, soldered to a hollow mask with water-circulation ring and water ducts, all made of copper. It cools the shutter housing and the runner plate, so that the edges of the film and hence the entire film-driving mechanism remains cold. This prevents the shafts from seizing up due to excessive expansion and ensures that the oil maintains its full lubricating power.

Even if, in winter, the projectionist should forget to drain the water, the risk of bursting overnight is very small, and if it should happen, the cooling unit can easily be removed and repaired and no harm is done to the mechanism.

It may be interesting to mention just one other advantage of water cooling. In one week the film is threaded in the projector 20 to 30 times and each time the same part of the film leader remains for about five to ten minutes in the gate before changeover takes place. When the gate is very warm, this part of the film dries out and becomes brittle, thus increasing the risk of rupture and of the film jumping off the sprockets. It will be obvious that in a projector with water cooling this risk is non-existent.

But even in the FP.5, which is not equipped with water cooling, there is a very handy method to avoid threading the film in a warm gate: the runner plate can be removed in one operation, without tools, and since a spare plate is supplied with every projector, the projectionist can easily replace the runner plate by a cold one after each reel of film. Owing to the very small tolerances in the thicknesses of the plates re-focusing is unnecessary.

The top and bottom sprockets of the FP.6 and FP.7 projectors are equipped with manual loop correctors, driven by differential gears and provided with a knurled ring. These loop correctors adjust the film loops to correct size directly after the film has been threaded or, when the projector is running, by braking the ring.

In the FP.7 projector the sound scanning part forms one entity with the projector mechanism and the entire film path is closed by a door with a large glass window. The

\* N.V. Philips' Gloeilampenfabrieken, Eindhoven.



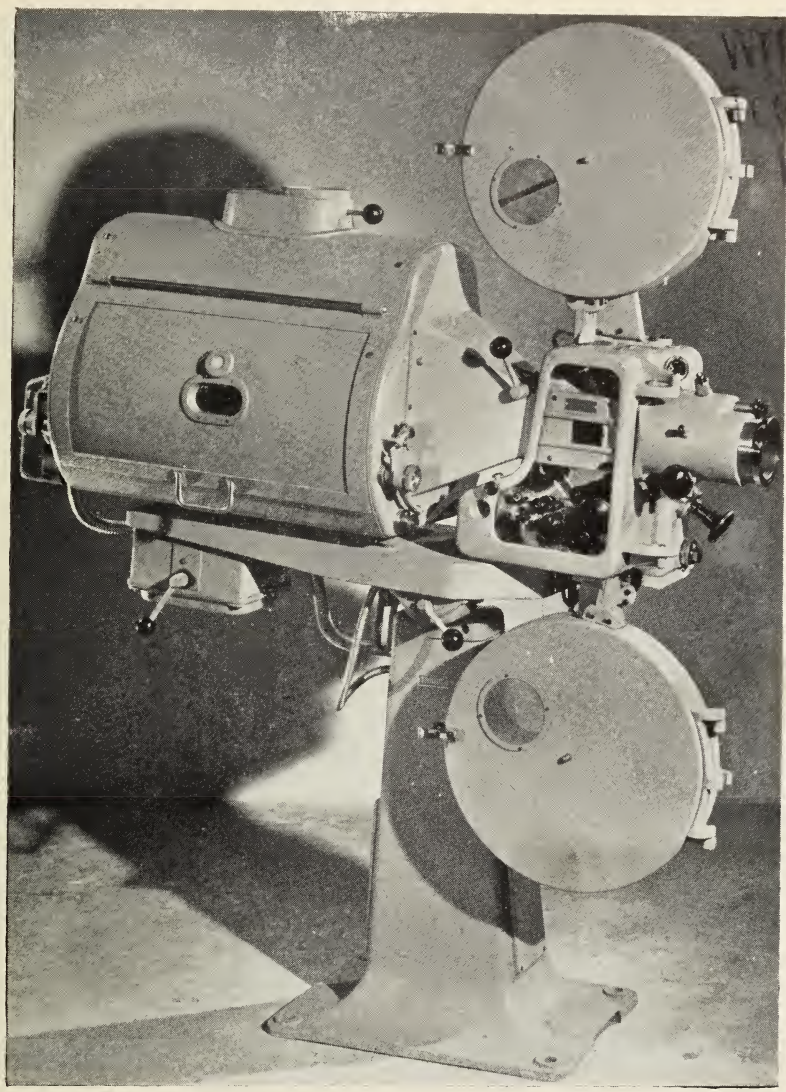


Fig. 1. The FP.7 projector

projector mechanism and the soundhead of the FP.5 and FP.6 form separate units, but apart from that, they are of the same construction and material as those of the FP.7.

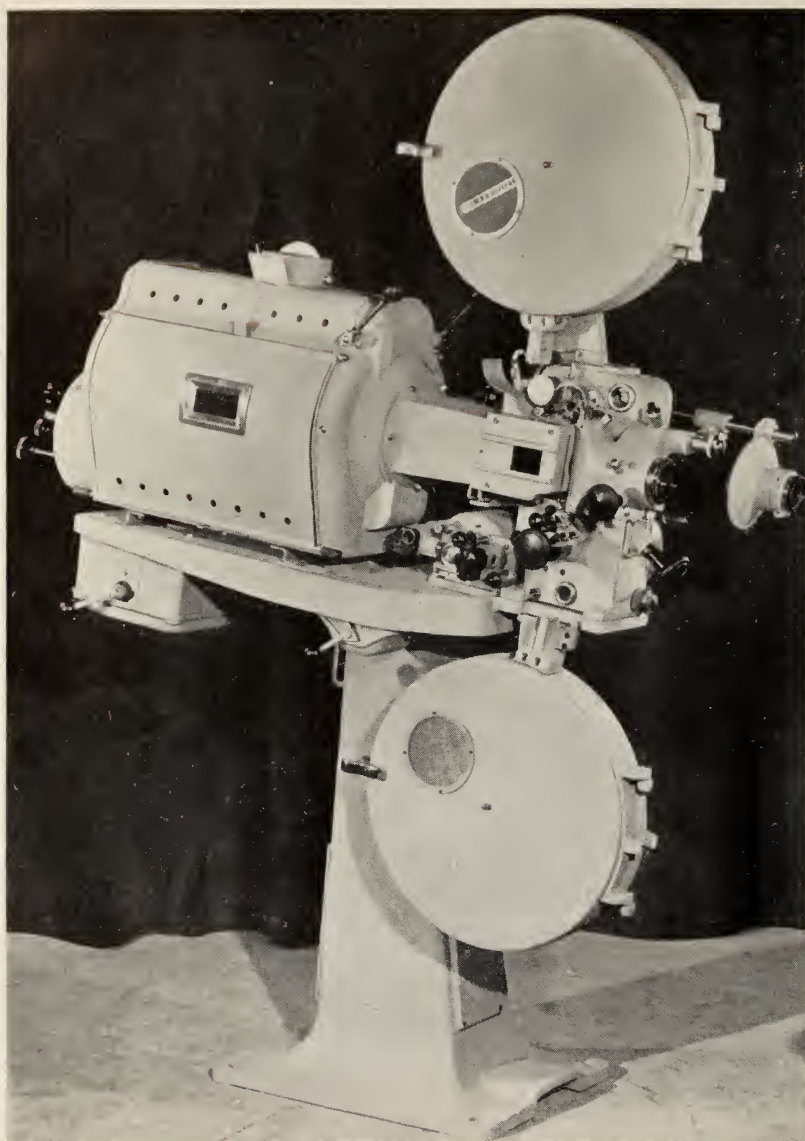
These examples illustrate that one design of projector has been adapted to the demands of all sizes of kinemas. When, for example, an owner of an FP.5 equipment wishes to replace his lamp house by a more powerful one, all he has to do is to replace the lens holder by a larger one and to build in a water-cool-

ing system. Moreover, since all vital parts of the three projectors are the same, the stock of spare parts is minimised and no great investments are involved.

### The Intermittent Unit

The Maltese cross and its shaft are forged from one piece of hardened chrome-nickel steel. The shaft of the locking cam is made of one piece of hardened cemented steel and the striking pin of hardened high-speed steel.

Wright-Patterson  
Technical Library  
Dayton, Ohio



*Fig. 2. The FP.5 projector.*

The shafts run in bearings of pearlite iron and as the expansion coefficients of steel and pearlite iron are practically the same, there is no risk of the shafts seizing up in an axial or diametrical direction, even at high temperatures.

The Maltese cross satisfies the highest standards both with regard to the precision of its manufacture and its excellent lubrication. It runs in a closed oil bath fed by a

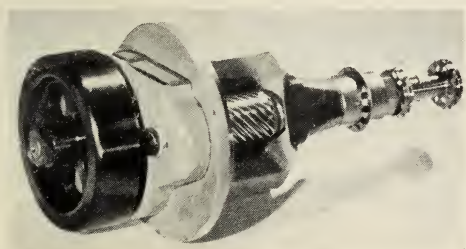
spur-gear oil pump. Before reaching the bath the circulating oil is filtered three times, once by a fine-mesh gauze filter and twice by magnetic filters. The shafts of the intermittent unit (Fig. 3) are provided with oil grooves which convey the oil from the bath to the bearings.

The intermittent sprocket is of unhardened chrome-nickel steel, and weighs only 16 grams, about  $\frac{1}{2}$  ounce. Owing to this very



low weight and to the fact that the points of the Maltese cross are bevelled, the forces needed to bring about the intermittent movement are kept as small as possible, thus minimising the wear of the Maltese cross.

The complete intermittent unit, which is fixed with only two screws, can easily be taken out of the projector.



*Fig. 3. The intermittent unit*

### The Driving Mechanism

The projector is driven by an asynchronous flange motor coupled to the main shaft by gear wheels. This shaft runs in ball bearings and is very massive (it has a diameter of

21 mm., about 13/16 inch), thus avoiding troublesome vibrations. The complete mechanism is shown in Fig. 4.

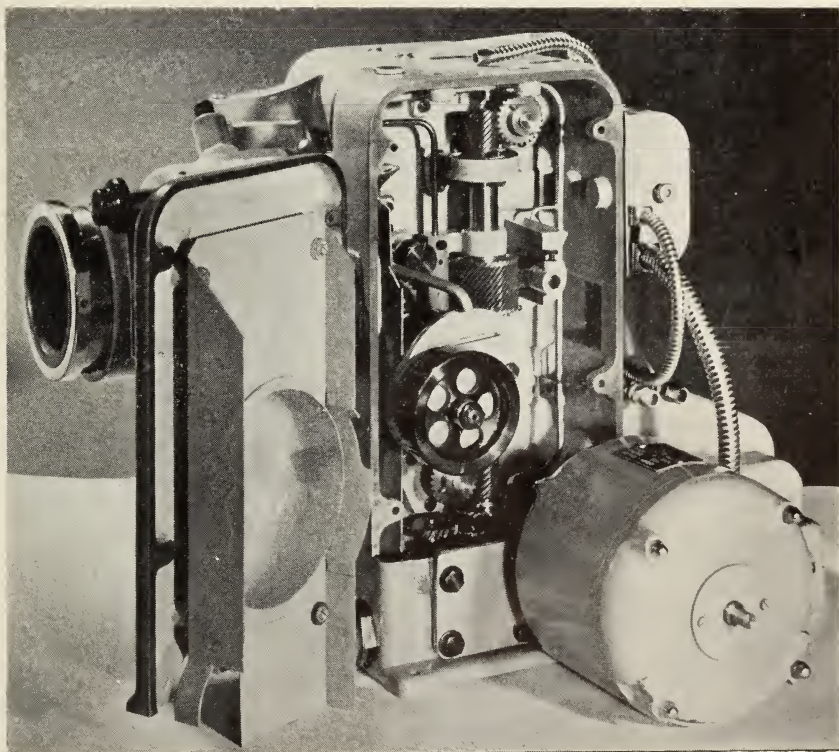
The main shaft drives consecutively:

- (1) the oil pump,
- (2) the shaft of the take-up sprocket,
- (3) the intermittent mechanism,
- (4) the drum-shutter and
- (5) the shaft of the take-off sprocket.

The friction device of the lower spool box is coupled direct to the main shaft by a vertical shaft.

The motor gear wheel is attached to the shaft by a friction clutch. This gear wheel will only slip under forces greater than the maximum motor torque, so that this safety clutch protects the mechanism against a breakdown in the not improbable case of the running projector being suddenly blocked, for example by a carelessly placed cloth or screwdriver.

Some of the gear wheels are made of a hard fabric, Novotext, which has a high resistance to wear-and-tear and also ensures silent run-



*Fig. 4  
The complete  
driving  
mechanism.*



ning. Unhardened and unalloyed steel wears out much more rapidly than Novotext. Wheels of Novotext combined with hardened



Fig. 5. The framing knob and disc.

steel have lives corresponding to decades of kinema-years.

The following test shows how strong the teeth are: The drum shutter of a normally running projector was blocked by means of the shaft of a hammer, and after this test was repeated several times, it was found that, although, of course, the shutter was damaged, no harm was done to the gear wheels.

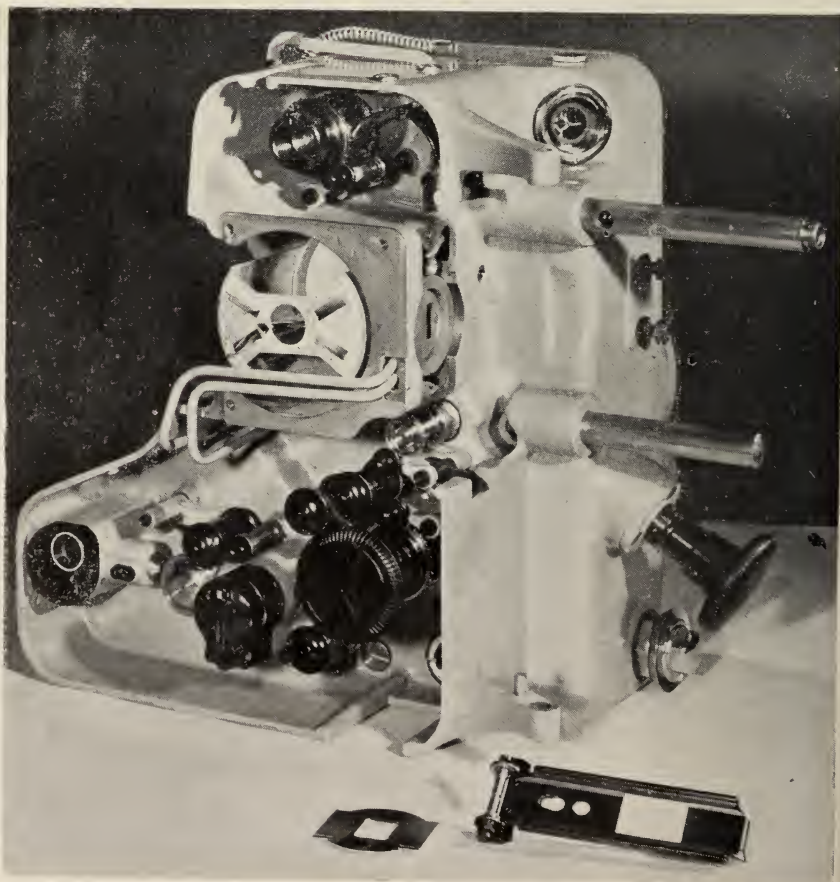
The intermittent mechanism is coupled with the main shaft by a resilient element which, together with the flywheel, ensures that the residual speed variations of the shaft of the locking cam are smoothly taken up by the driving mechanism of the projector. This construction guarantees not only a smooth running projector but a considerably longer life.

### The Framing Device

The framing knob turns the complete intermittent mechanism round the centre of the shaft of the intermittent sprocket (Fig. 5).

Fig. 6

The film driving mechanism of the FP.7 projector, showing the drum shutter and water cooling system.



This causes a momentary change of speed of the pinion on the shaft of the locking cam—since this pinion revolves around its driving

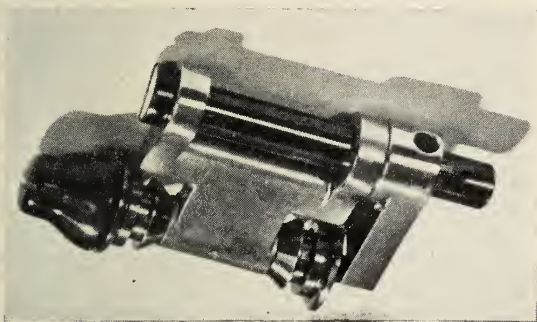


Fig. 7. The pad roller.

gear—and consequently also a momentary change of speed of the intermittent movement.

in a very simple way. The shaft of the locking cam is blocked in the intermittent mechanism, for example by pushing a wooden wedge between the flywheel and the frame of the Maltese cross. When the framing knob is turned the shaft of the shutter remains stationary.

### The Shutter

All three projectors use a drum shutter (Fig. 6), which cuts off and liberates the light beam from two sides, thus making the time of interception as short as possible and ensuring maximum light efficiency. The shutter and its housing are so dimensioned that they give free passage to a light beam produced by a mirror with an aperture of F1.4. This means that there is no loss of light, even when using very powerful arc

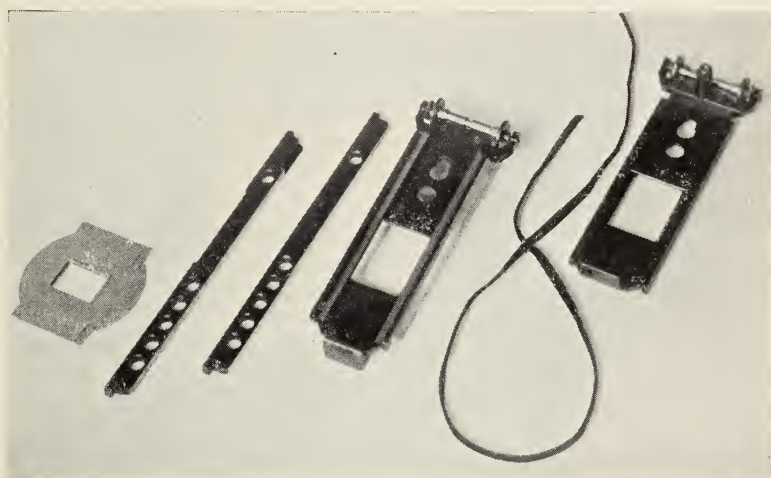


Fig. 8

The film mask, pressure  
skates and the runner  
plates.

In order to maintain synchronism between the Maltese cross and shutter, the speed of the shutter shaft has to be changed correspondingly. For this purpose the gear wheel which drives the pinion on the shutter shaft is mounted in a fork which can be moved upwards or downwards on the main shaft. The pin attached to the fork runs in a spiral groove in the framing disc to which the intermittent unit is fixed and as this disc is turned the speed of the shutter is changed in accordance with that of the intermittent movement.

The perfect synchronism between intermittent mechanism and shutter can be proved

lamps and lenses with the largest apertures.

The shutter has spring-loaded flaps which cut off the light beam in any position of the shutter when the projector is not running or when its speed is less than 8 frames per second. As soon as the speed is higher, the flaps open by centrifugal force and then act at the same time as ventilating blades.

The perfect synchronism in any position of the framing device and the small play in the gearing between the shutter shaft and the shaft of the locking cam have made it possible to reduce the angle of the shutter blades to 83 degrees, and to obtain a light efficiency



of 54 per cent. (against about 45 in most projectors), without any sign of travel ghost.

### **The Automatic Film-loop Correction during Framing**

It is important that the sizes of the film loops above and underneath the film gate are not altered during framing.

There are two factors which affect the sizes of the loops:

1. the intermittent sprocket being turned round its shaft and
2. the speed of the shaft of the locking cam being changed.

These two factors counteract each other and we found that they compensate each other completely by making the ratio between the pinion on the shaft of the locking cam and its driving gear 4:1.

This may be illustrated by the following example:

Let us suppose the framing knob is turned from the extreme right-hand to the extreme left-hand position, *i.e.* the framing disc is turned  $90^\circ$ , thus shifting the film one full image in its running direction. By doing so, the pinion on the shaft of the locking cam revolves around its driving gear and when the transmission ratio between these gears is 4:1, the shaft of the locking cam will be turned backwards  $4 \times 90^\circ = 360^\circ = \text{one revolution} = \text{one image}$ . A displacement of the film in one direction is therefore completely compensated by the displacement of the film in the opposite direction. The advantage in practice is that framing can be carried out without any risk of the film loops becoming too large or too small.

### **The Lubricating System**

Lubrication of the Maltese cross and of the driving mechanism is by spur-gear oil pump located in the oil receptacle of the projector. This makes a suction duct superfluous, and moreover, the pump can never fail.

Having passed a fine-mesh gauze, combined with a magnetic filter, the oil is forced into a duct with outlets leading to the various lubricating points. The duct ends at the top of the projector, just above a second magnetic filter, over which the oil flows towards

the intermittent mechanism. This second filter is placed behind a viewing glass for checking the oil circulation.

The magnetic filters hold back all steel and iron particles from the oil, reducing wear of the mechanism and acidification of the oil; they are readily removable.

The rear of the projector is closed by an oil-tight cover provided with a special oil screen, which prevents the oil from penetrating between the contact surfaces of the cover and the projecting housing. Consequently, it is unnecessary to use a gasket, which is liable to break when the cover is removed, or a liquid packing which takes 12 to 24 hours to dry.

Oil retainers prevent the oil from leaking along the shafts of the driving mechanism, so that there is no risk of the oil soiling the film.

The shafts of the upper and lower spool boxes run in self-lubricating ball bearings.

### **The Film Path**

All the sprockets are made of chrome-nickel steel which has a high resistance against wear. They are easily removed from their shafts and when remounting need only be pushed against the stop and fixed in that position, when they are automatically aligned.

The three pad rollers (Fig. 7) are of exactly the same sturdy construction. They are blocked in their released position, thus facilitating threading the film.

Two velvet-covered runner-plates (Fig. 8), which can be interchanged without tools, are supplied with each projector. The velvet tape is stretched over the running surfaces of the plate by means of a spring.

A big advantage of velvet-covered runner-plates is that accumulations of film dirt when running new prints is avoided. When a plain steel plate is used, the dirt may form hard ridges which are liable to damage the film.

Another advantage is that, since the friction coefficient between film and velvet is much higher than that between film and smoothly polished steel, the pressure of the skates can be reduced considerably, thus ensuring a longer life of the skates.

The third advantage is that only the cheap



velvet tapes wear out and not the steel runner-plate itself.

Only when running older, somewhat torn film prints, is it better to use a plain steel runner-plate, since older prints might catch on the velvet.

The pressure of the skates is adjusted by means of one central screw, ensuring that the pressure is uniformly distributed over the full length of the runner-plate. The skates are made of Novotext. They are very light in weight—the specific gravity of Novotext is only 1.4—and have a great resistance against wear-and-tear. They can be replaced without tools.

The lengths of both runner-plate and pressure skates are such that a well-made splice is just at the beginning or the end of the runner-plate at the moment the inter-

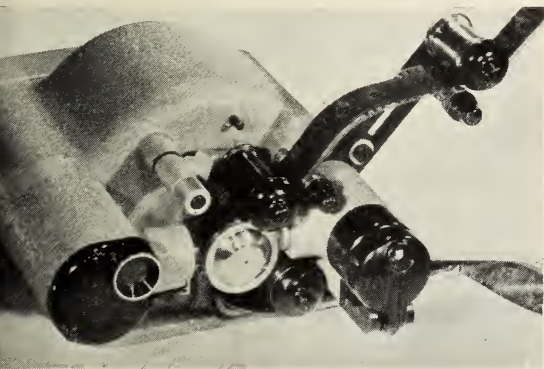


Fig. 9. The soundhead.

mittent sprocket is at rest. Hence the velocity at which the splices enter or leave the gate is virtually zero, greatly reducing the danger of film rupture. Moreover, splices pass absolutely noiselessly and picture jump is precluded, since the skates are shifted gradually over one extra thickness of film.

The pressure skates are spring-loaded in the casting which forms the lens holder. On pressing a button the casting glides on two rods, liberating the runner-plate for threading the film. In its closed position it is pushed against a stop by a strong spring, ensuring correct focusing of the lens.

The pad roller of the intermittent sprocket is closed automatically when the lens holder

is pushed back into position ; it can also be closed independently of the lens holder.

The Picture Aperture

The FP.7 projector is provided with an adjustable roller which allows the length of film between the picture aperture and the sound scanning spot to be shortened from 20 to 17 frames. This is of great advantage for longer halls in which the sound takes more time to reach the audience in the back rows. By means of the adjustable roller a compromise can easily be found. After having passed the silencer rollers the film is pushed

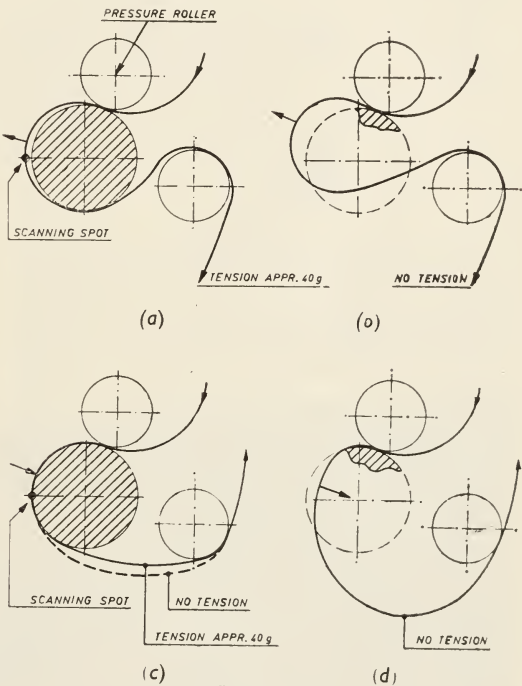


Fig. 10

by a spring-loaded steel roller on to the rotating sound drum (Fig. 9).

The problem of ensuring a constant film speed at the sound-scanning spot has been a source of difficulty for designers since the earliest days of the sound film. It is true that the introduction of the rotary sound drum brought a great improvement, but it did not solve the problem completely and even now the most diverse constructions are used for eliminating vibrations in the direction of film travel, caused by the projector mechanism

and by sprocket teeth engaging the perforations.

A frequently used construction is that of

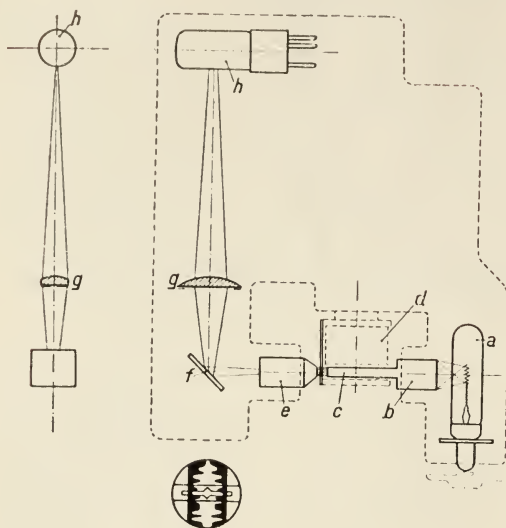


Fig. 11

*Path of the light rays for normal sound reproduction.*

one or more guide rollers on a pivoted mount which is often air or oil damped. The task of this mechanism is to prevent the vibrations

from being propagated to the sound-scanning spot.

This construction, however, is only partially satisfactory and is unnecessarily complicated, because the film itself can be used as a perfect mechanical filter. When a film is stretched with a very small force over a roller, slack and resilient bends will be formed on either side of the roller. These bends eliminate vibrations of any frequency—provided that the amplitude is not too large—since in the first place the film material has very small mass and in the second place the bends act as frictionless springs. It is well known that the lower the tension on the film, the better the elimination of longitudinal vibrations.

Now, if both the sound drum and its pressure roller run in ball bearings, and if the bearings are lubricated with oil instead of grease, the tension on the film can be kept as low as 40 grams, about  $1\frac{1}{2}$  ounces.

In order to eliminate even the largest amplitudes, it is necessary to increase the number of bends, which can easily be done by inserting one or more rollers in the film path between the sound drum and the take-up sprocket.

However, due to the very low tension, the film is no longer sufficiently in contact with the sound drum. If no special measures were taken, the film would make very small and rapid movements perpendicular to the surface of the drum, giving the effect of a drum of varying diameter. These movements would hardly be visible with the naked eye, but would cause scanning faults due to



Fig. 12

*The position of the sound track*

the sound track being momentarily out of focus. This would result in a perceptible distortion in the reproduction of the frequency range between 4,000 and 7,000 c/s.

We have found a solution to this problem in which the tension on the film remains so low that the filtering action of the slack bends is largely sufficient, without distortion being caused. Since film material has a certain rigidity, we have placed the sound drum and some guide rollers in such a way that the film retains sufficient pressure against the sound drum even when the tension is zero.

Fig. 10 (a) shows the construction with a pivoted lever and the film forming an S-bend. There is no good contact between film and sound drum at the scanning spot when the tension is sufficiently small.

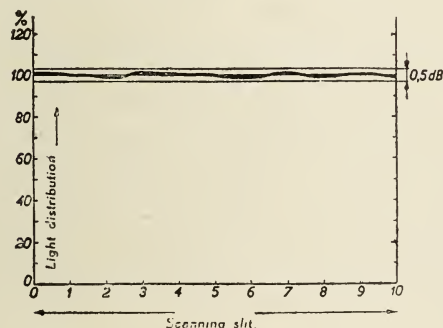


Fig. 13. Slit illumination curve.

Fig. 10 (c) shows our construction in which the film forms a U-bend and where good contact is ensured even when the tension is zero.

Figs. 10 (b) and (d) show how the film would behave if part of the sound drum were removed. This can easily be verified with a length of film and some rollers. In Fig. 10(b) the film moves away from the drum and in Fig. 10 (d)—our construction—it moves towards the drum.

This construction is patented in several countries. It is extremely simple and eliminates completely the use of springs and damping systems which, besides needing adjustment from time to time, may also give rise to "wow" and flutter. We have used the same construction in our recording

machines which must satisfy the highest demands in this respect.

## The Sound-scanning System

Both the sound-scanning part of the FP.7 projector and the type 3837 soundhead used with our FP.5 and FP.6 projectors are equipped with a "macro" optical system (Fig. 11). In this system the light of the exciter lamp (a) is projected on to the end of a glass rod (b) by means of a condenser system (c). The glass rod conducts the light by total reflection through the sound drum (d) towards the film. Thus, a small and very

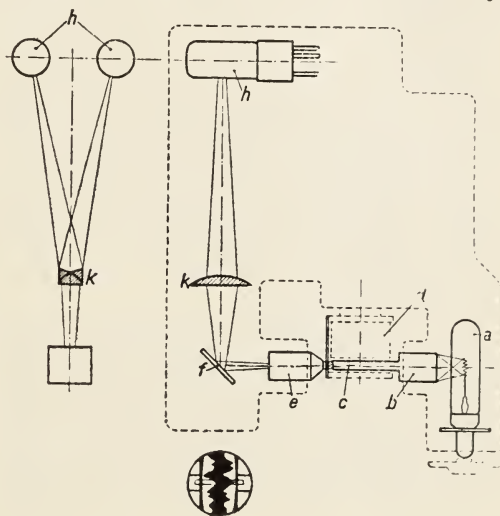


Fig. 14.

*Path of the light rays for dual-track sound reproduction.* intense light spot is thrown on to the sound track.

This intensely illuminated sound track is enlarged 13.5 times by means of a carefully calculated micro lens (e) and projected on to a screen with a narrow slit, via a mirror (f). Directly behind the slit is a condenser (g) which concentrates the light falling through the slit on a highly sensitive photocell (h). The mirror (f) deflects the path of the light rays 90°, making it possible to place the photocell at the rear of the soundhead, thereby reducing its dimensions and making cell changing easy.

The position of the sound track with respect to the scanning slit can be shifted by axial displacement of the pressure roller on the



sound drum. It can be checked by looking at the screen with slit, visible through a viewing glass (Fig. 12).

The optical system is provided with separate devices for focusing and azimuth adjustment.

The illumination of the slit is very uniform and consequently the variation in output, measured over the entire length of the slit, is less than 0.5 db (Fig. 13). The exciter lamp is pre-focused and can be replaced in a few seconds.

The photo-cell has a remarkably low microphonic effect owing to the photo-cathode being precipitated on the inside of the glass bulb.

Another advantage of the "macro" optical system is that the light beam falling through the slit can easily be split into two or more parts, each exciting a separate photo-cell. Consequently, the soundhead can readily be adapted to push-pull or stereophonic reproduction (Fig. 14).

### The Safety Devices

Our projectors offer the greatest safety. The fire traps are of adequate construction, the spool boxes are provided with fine-mesh gauze windows. The shutter flaps cut off the light beam when the speed of the projector becomes dangerously low and they cool the

shutter housing and film when the projector is running at its normal speed. The mechanism and film are cooled in a very efficient way by water cooling.

### The Automatic Film-rupture Device

This consists of a mercury switch and two hinged, curved brackets, between which the upper film loop passes. The device operates if the upper film loop becomes too long or too short, which may happen when the film stops in the gate or when the perforations are so badly torn that the take-off sprocket can no longer pull the film out of the upper spool box. The film loop will then strike against either the upper or the lower bracket, thereby cutting off the light beam and switching off the motor and exciter lamp.

### The Air Cooling

All the projectors are equipped with the necessary air duct for the connection of a cold-air blower or a compressor; this duct ends above the mask, in front of the film, which is cooled efficiently. Air cooling in itself does not give complete protection against the film catching fire, but has the advantage that fire is restricted to one image. For this reason, air cooling is prescribed in many countries when H.I. arc lamps are used.

## BOOK REVIEW

*Books reviewed may be seen in the Society's Library*

**AGFACOLOR**, by Dr. Heinz Berger, Agfa Ltd., 25s.

Although this book deals with still photography rather than cinematography, there is much in it that is common to both fields which should therefore be of interest to those concerned with the Agfacolor or similar processes of colour cinematography.

The first third of the book deals with historical and theoretical considerations. The history is brief but complete, and is specially interesting when it deals with the relatively recent story of the development of the Agfacolor processes between 1936 and the present time. The basic theories of colour reproduction are then explained, with particular emphasis on multi-layer materials. The explanations are illustrated with a number of very well designed diagrams printed in six colours and black.

There follows a chapter on the special points of

the Agfacolor processes, including explanations of the various causes of off-balance colour results and the rules for removing or reducing these errors by means of colour correction filters.

The second and larger part of the book is devoted to the techniques of the various Agfacolor still processes, particularly the paper print making process. This part of the work is again very well illustrated in colour—but this time with numerous four-colour half-tones. In fact, the standard of production of this book is very high indeed, and each copy actually contains an original Agfacolor print as a frontispiece.

The book ends with a collection of relevant tables and formulæ, so that everything seems to have been included that might possibly be required by a photographer starting out to expose or process any of the available Agfacolor materials.

JACK H. COOTE.

## FILMING RADAR

John R. F. Stewart, A.R.P.S. (Member)

*Read to a meeting of the British Kinematograph Society on January 2, 1952*

**D**URING the war the T.R.E. Film Unit made for the most part two-reel operational training films for most new radar systems as they came into use with the Services. They were mainly concerned with airborne radar for the Royal Air Force, but some were also made for the Navy.

Perhaps the most important part of using any radar equipment is the interpretation of the picture given on the cathode ray tube. Obviously in each of these training films, besides the usual shots of hands turning knobs and diagrams explaining the theory, there would be a large number of scenes showing the tube face display. In many cases very subtle differences in this display would mean a great deal to the equipment operator.

All tube displays are, in the first instance, made up of a spot of light, which moves rapidly across the tube face and can be made to produce various patterns. According to the type of fluorescent screen on the tube, this pattern is of various colours, usually blue or green.

The oscilloscope is a simple pattern, much simpler, in fact, than most radar displays. There is no particular difficulty in filming this. The brilliance of the trace is variable, but over a certain brightness it becomes out of focus. Generally one works with the maximum brilliance possible before de-focusing occurs. With a blue trace and Plus X or Series III good results are obtained at  $f/2$  or  $f/2.8$ . With a green trace, the Ilford 5G91 recording film is very suitable at the same apertures.

A training film on the GEE-H radar system, which shows a simple type of display (Fig. 1) was made. However, even on this display some parts of the trace, where the spot is moving rapidly, were difficult to record. Sometimes filming at 12 frames per second is possible; in other cases the circuit of the display unit can be modified to brighten up these faint sections without affecting the

rest of the trace. There can be other minor complications on this type of display.

The picture in Fig. 2 is rather an interesting one, for two reasons. First, there is a scale in front of the tube, etched on a piece of Perspex. This scale was lit by reflected light from a white card. The card was lit by a single unit, either spot or a photoflood lamp, controlled by a dimmer. In this case, shooting at 12 f.p.s. with  $170^\circ$  shutter opening, the light on the scale was 4 foot candles, and the film stock Ilford 5G91.

The second point about this display is that the picture only occupies one-half of the tube screen, and is being switched rapidly from side to side 20 times per second. If this scene had been filmed at the normal 24 f.p.s., strobing effects would have been noticeable.

### The Plan Position Indicator

About 1943, a new type of display was introduced—the plan position indicator. When these displays first appeared, it was considered quite impractical to attempt to film them, and for some little time they were represented in the T.R.E. films by animated diagrams. However, the difficulties were overcome and a modern example of a plan position indicator display unit is shown in Fig. 3.

With this type of display, the main time base starts at the centre of the tube and goes out to the edge. It then rotates like the hand of a clock. As it rotates parts of it brighten and leave behind a glowing patch of light, not very much brighter than the luminous numbers on a watch. This luminous patch fades away or decays, in anything from one to 20 seconds, and it is repainted again as the rotating time base comes round. The tube is coated with two layers of fluorescent material, the first layer excited by the electron beam and producing the time base, while the radiation from the time base excites the other layer, which has a much longer persistence of glow.





Fig. 1. GEE—H radar tube display.

Fig. 4 is one kind of P.P.I. display. This is from the H<sub>2</sub>S airborne radar system, and represents a plan of the ground beneath the aircraft. The bright parts are land and the dark parts sea.

There are many problems involved in filming a plan position indicator so as to get the most accurate reproduction possible on the screen. Very often P.P.I. displays are filmed by exposing one frame for each complete rotation of the time base. This gives an excellent speeded up record of the tube face picture, which is useful for certain purposes, but does not give the correct appearance of the display because there is no

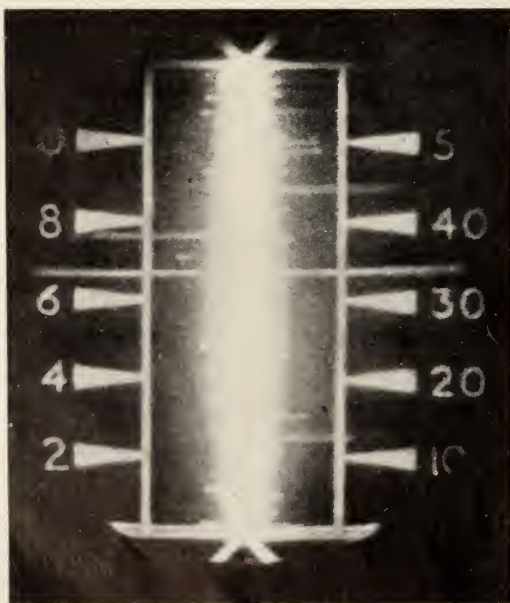


Fig. 2. The scale in the front of the tube, which was etched on Perspex.

rotating time base or decay of afterglow. This technique should not be confused with filming the tube picture at the normal 24 f.p.s.

The first problem is simply that of recording the very faint glow left behind by the rotating time base, when the exposure is limited to 1/50th second. A camera with a shutter opening of more than 180° would have been useful but was not available. The fastest possible lens was obviously the first requirement. The one used was a Cooke f/1, 2¼ ins. bloomed (Fig. 5), specially mounted on a Bell-Mitchell camera.

Of course, the lens has disadvantages for normal use. The rear element is very near the focal plane and, in fact, even with special mounting it was not possible to focus on anything farther away than about 5 feet. How-

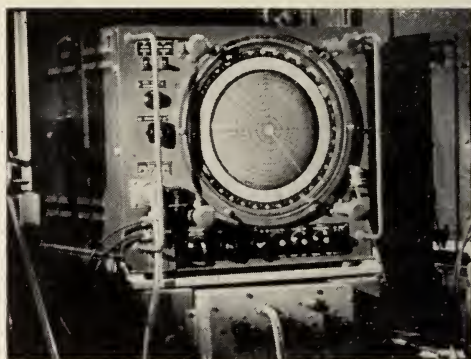


Fig. 3. A modern example of a Plan Position Indicator display unit.

ever, this was entirely adequate as the largest tube face it was required to film did not exceed 15 ins. in diameter.

Curvature of field was pronounced, but not being interested in the edges of the frame, which would be black, this defect did not matter.

The choice of film stock, of course, depended on the colour of the fluorescent afterglow screen—in the case of H<sub>2</sub>S this was yellow green.

The spectral emission of the afterglow is shown in Fig. 6. It will be seen that the maximum is at approximately 560 mμ.

The film stock which gave the best results was the Ilford 5G91. The peak sensitivity of this film is also approximately 560 mμ.



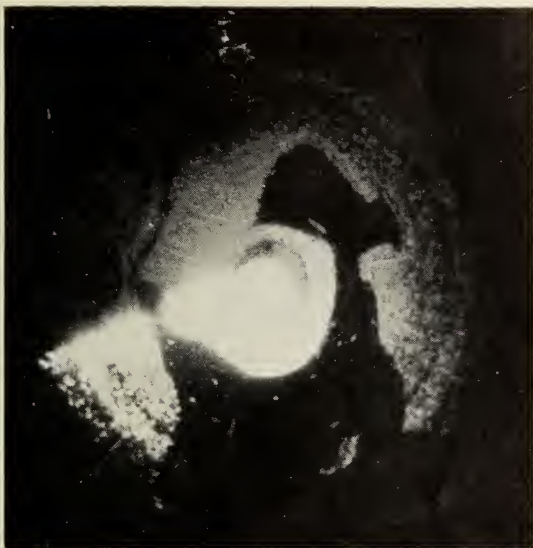


Fig. 4. The  $H_2S$  airborne radar system.

Preliminary tests with the F/1 lens and 5G91 film were encouraging, but not good enough. An observer looks at a P.P.I. display either in a darkened compartment or through a rubber visor which cuts off all the light from the tube face. So far we also had been filming the displays in complete darkness, but now we tried a very small amount of light on the tube face. There was a great improvement and it seems that this incident light has the effect of pushing the exposure over the toe of the H. and D. curve of the emulsion.

It will be appreciated that the amount of

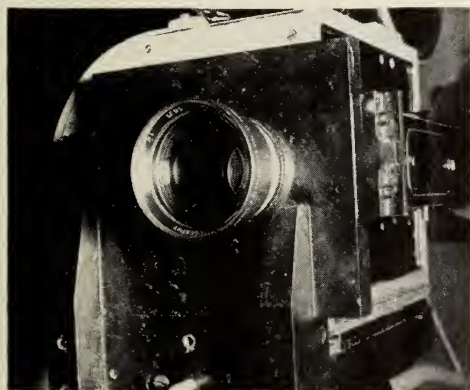


Fig. 5. A Cooke F.1  $2\frac{1}{2}$  inch bloomed lens.

light was very small indeed. It varied between 0.1 and 0.5 foot candles and it was measured on a street lighting photometer which used a photo-electric cell coupled to a mirror galvanometer. The light was provided by a 25 w. opal incandescent lamp in a reflector and heavily diffused. The brilliance was controlled by a dimmer.

It was now possible to obtain quite good results in recording afterglow at 24 f.p.s. with

#### YELLOW GREEN AFTERGLOW.

EMISSION FROM 4700 TO 6400 Å  
PEAK AT 5600 Å

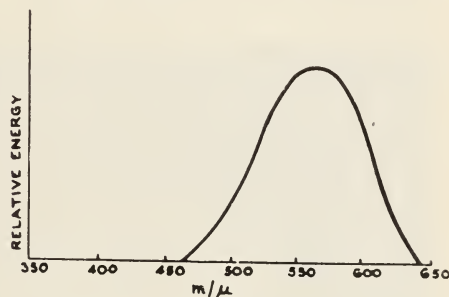


Fig. 6. The light emission of the afterglow.

#### BLUE TIME BASE.

EMISSION FROM 3600 Å. TO 5200 Å.  
PEAK AT 4400 Å.

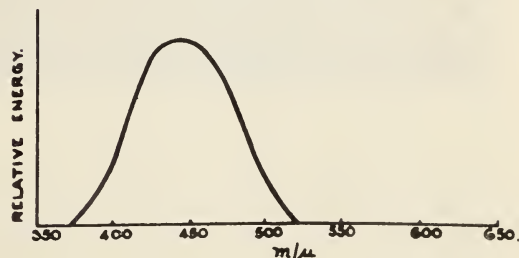


Fig. 7. The light emission of the time base.

normal laboratory processing. But we had difficulty with the rotating time base, which was blue in colour and so much brighter than the afterglow that it was now considerably over-exposed, and light scatter in the emulsion and from the film base caused the thin bright line to spread considerably and cover quite a large part of the afterglow pattern.

Fig. 7 shows the spectral emission of the

time base, which extends from 360 to 520 mμ.

Obviously a filter was necessary, but we certainly could not afford to lose any light from the afterglow. Experiments showed that the most satisfactory filter was the Wratten 16. This has an almost straight line cut off at 520 mμ and transmits almost everything at 560 mμ.

It was now possible to record this type of picture on the H<sub>2</sub>S type of radar, when the time base rotated at approximately 40 r.p.m. or faster, as shown in Fig. 8.

A different type of picture, again, can be obtained when an aircraft is flying over the



Fig. 8. An H<sub>2</sub>S radar picture of a city.

sea. The spot of light in Fig. 9 represents a ship, while the bright patch in the centre is caused by the radar waves being reflected from a rather rough sea beneath the aircraft. The thickness of the time base is largely due to its movement during the 1/50th second exposure. In this scene, incidentally, the radar scope picture has been optically married to the front of the radar unit.

All the displays so far mentioned have been of airborne types. Of course, there are many extra difficulties involved in filming in the air, but if it were just a case of obtaining a



Fig. 9. An H<sub>2</sub>S radar picture of a ship at sea.

film of whatever happened to be showing on the radar set, it would not be so difficult. The following is the description of the scene from the shooting script of a radar film:

C.U. P.P.I. 10/30 mile range.

Ship echo at six miles closing in.

Sea returns extending from 3-3½ miles.

Some land bottom right hand corner.

Time base stops on echo.

It will be appreciated that the difficulties of co-ordinating all the variable factors, including the weather, are great.

### Radar Trainers

Fortunately, there were available special radar trainers which could produce almost any type of picture on the cathode ray tube. Naturally, the appearance of each display

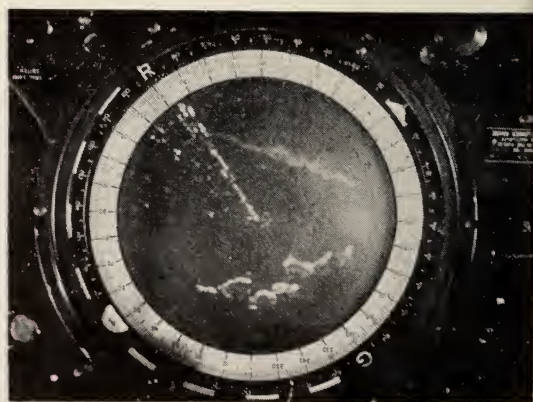


Fig. 10. The result obtained when the maximum amount of afterglow was desired.



was carefully vetted by an experienced radar observer before it was accepted for filming.

The trainer which produced the  $H_2S$  picture was basically a tank of water, about 4 feet square and a few inches deep, in which was suspended a rotating crystal which transmitted pulses of supersonic frequency. These pulses hit the bottom of the tank and were reflected back. This set-up reproduced in miniature an aircraft in flight, transmitting radar pulses which are reflected from the ground.

A sheet of glass was placed in the bottom of the tank. On this sheet of glass, clusters of carbon granules represented towns, sand-blasted areas represented land, and clear glass represented sea. It was found these three types of surfaces reflected the supersonic

sequence represent a ground type of radar set—G.C.I.—and the time base rotation is very much slower than on the airborne types. The photographic technique which has been so far described, while satisfactory with airborne displays, with a 40 r.p.m. time base rotation, did not give such good results with a slower speed.

There are some faults in these radar tube pictures. The echoes of the two aircraft did not persist for very long, and there was considerable flare from the rotating time base. On one naval radar which we had to film the time base rotates at only  $4\frac{1}{2}$  r.p.m., or one-tenth the speed of the airborne equipment. Instead of having to record afterglow for about a second and a half, it was now necessary to try to record it over 15 seconds. So

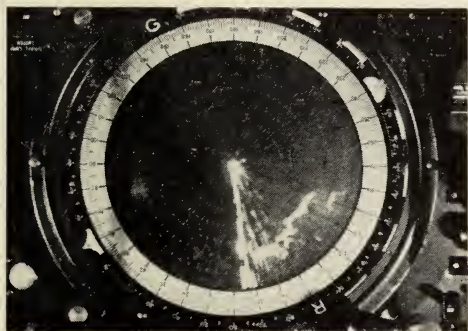


Fig. 11. The flare when the time base is passing over the brightest parts of the picture.

pulses, in much the same way as actual towns, land and sea reflected radar pulses. Small pieces of metal, such as nuts, placed in the sea areas, gave echoes very similar to ships or aircraft.

If the length of the shot justified it, it was easy enough to get our "ships" and "aircraft" to move. The scanning beam only passed over them every few seconds, and in between each scene the nuts could be pushed along the bottom of the tank with a stick.

It is interesting to note that the two echoes on the radar tube, representing two aircraft approaching rapidly together and likely to collide at any moment, in the film "School for Secrets," were in fact produced by pushing two  $\frac{1}{4}$  in. nuts together along the bottom of a tank of water. The radar pictures in this



Fig. 12. The result obtained when the tube face picture was married to the rest of the unit by back projection.

two improvements had to be aimed at—less flare and more afterglow.

The first question asked was whether we could find a C.R.T. screen photographically more suitable than that used in the standard equipment. Several were tried and one was found which seemed to combine the two characteristics needed: a long afterglow and a low brilliance ratio between the afterglow and the rotating time base. The colour of the afterglow on this screen was orange-red. The 5G91 emulsion that had been used up to now was obviously no longer suitable as its red sensitivity is extremely low.

A number of stocks were tried out and good results were obtained with the Ilford Pan Cine Negative Series III, which has very



high sensitivity at the red end of the spectrum. The colour of the time base was blue, and the Wratten 16 was still the most suitable filter to cut down the time base brilliance with least effect on the afterglow.

There were some very difficult displays to film, and to record the maximum possible amount of afterglow there were two more things that could be done. The first was to speed up the time base rotation to double its normal speed and then make an optical in which each frame was printed twice, thus bringing things back to normal.

The slight jerkiness of rotation which this produced was compensated for, it was felt, by the improvement in the afterglow.

Secondly, processing facilities were available at T.R.E., and the film was developed in a special bath of Pyro-Metol, with results shown in Fig. 10. The time base of the ship's radar in this print is rotating clockwise, and it will be seen that the afterglow is recorded right up to the time when it is repainted. The dots in the centre represent the other ships in the convoy.

The original speed of the time base rotation on this equipment was  $7\frac{1}{2}$  r.p.m. This was speeded up to 15 per minute for filming and then brought back to  $7\frac{1}{2}$  by printing each frame twice.

In Fig. 11, where the time base is actually passing over one of the brightest parts of the picture, the flare is quite reasonable.

In combining the tube face picture with the scale and the rest of the unit, straightforward optical marrying was used; the front of the display unit having been filmed against dark material, dark grey celluloid was used over the tube face.

But for a scene like Fig. 12, where the radar operator marks the position of echoes on the face of the tube, back projection of the tube face seemed the practical answer. There were no normal facilities at T.R.E., but as the back projection picture would only be 12 inches in diameter, it seemed possible that 16 mm. might be satisfactory. The 16 mm. projector used was an Ampro with a 300 w. lamp and a 2-inch lens.

## DISCUSSION

Mr. W. J. RAYMONT: What lenses were used in photographing the oscilloscope faces?

THE AUTHOR: The tube face shots of the plan position F.1 2½ ins. Cooke indicator types were filmed with a lens specially mounted on a Bell Mitchell camera. The ordinary direct type of traces, such as seen on the oscilloscope, were filmed mainly with a Newman with 2 ins. and 3 ins. F.2 Cooke. The composite pictures were filmed on a Mitchell with similar lenses.

Mr. WHEELER: How were the shutters interlocked on the B.P. effect?

THE AUTHOR: We conducted tests with the 16 mm. projector and filmed each scene three times. The projector was set by means of an ordinary stroboscope to the speed it ought to be, and then running slightly faster and slightly slower. We then chose the best of the three. There was no synchronism between the two at all.

A VISITOR: I presume that with the fluoride screen flash is no longer present.

THE AUTHOR: There are probably better tubes with fluoride screens now. At first, the American training films had very good tube face pictures.

Mr. H. WAXMAN: I used Tri X when shooting the tube faces in "School for Secrets."

THE AUTHOR: My own personal experience was that Series 3 was much better in every way. I

have always felt that Tri X was not really very much use.

Mr. B. HONRI: Have you tried latensification for the weak exposures?

THE AUTHOR: No.

Mr. N. LEEVERS: I should like to ask Mr. Stewart a question concerning the pictures of the plan position indicator, which were shot at double normal speed and then stretched by double frame printing. I take it some of the last pictures in the film were done this way, when the whole tube face was shown, because the radial scanning line went round like an impulse clock, and at the same time the after glow seemed to exhibit radial lines of higher intensity than the areas in between. In other words, you get the "spoke of a wheel" effect round the after glow.

THE AUTHOR: I think this was interference on the tube face. I do not think there is any connection with the intermittent motion.

A VISITOR: Was this anything to do with the repetition rate of the scan? One has to be very careful when trying to film at speed, otherwise you see individual traces.

THE AUTHOR: That is a possible explanation.

Mr. N. LEEVERS: I do not see how the rate of scan has any bearing on what appears as an after glow.

## EXPOSURE FOR COLOUR

J. H. R. Coote, F.R.P.S. (Member)

*Adaptation of a lecture given in the Kine Camera Technique Course on December 10, 1951*

IT is sometimes thought that anything that is said about exposure for colour will apply in general to all present day colour processes, but this is not the case. There are basic differences between the multi-layer processes (such as Kodachrome, Ansco-color, Agfacolor, Gevacolor and Eastman Color Negative) and the three-strip processes typified by Technicolor. These differences are not just related to the way the colour images are formed, but commence with the camera exposure.

One way of drawing attention to these differences is to point out that whereas we can talk of exposing Kodachrome or Ansco-color or Gevacolor films, we can only talk of using a Technicolor camera—which is a very different thing.

Since the three-strip method is being used for something like 90% of motion picture production, it seems reasonable to deal with that method first.

### Three-strip Camera

Technicolor three-strip cameras were first used in the early 'thirties, and now, almost 20 years later, a new batch of almost exactly similar cameras have been built by Newall and put into service alongside the original units. It seems obvious that J. A. Ball, who was largely responsible for the original design and who has recently died in America, must have done an exceptionally fine job.

The principles underlying the three-strip method are fairly well known: a beam-splitting prism is placed behind a single lens so that part of the light is reflected at right-angles towards a pair of films which we know as a bi-pack, while the remainder—minus a small proportion that is lost by absorption—is transmitted to a third film.

In order to obtain images of identical size and with precisely the same relationship between the images and the corresponding perforation holes, certain adjustments must be

provided for the beam-splitting prism. On the other hand, once the prism has been correctly set, it must be possible to remove it easily for cleaning and yet replace it in precisely the same place again. Technicolor's prism mount assembly comprises a knife edge working in conjunction with a vee-shaped groove in the underside of the prism platform, and a single screw fastening to lock the platform in position. The prism of the British Tricolour camera is held in a mount which in turn slides to a stop in a dovetailed guide.

Since it is the policy of Technicolor to supply their cameras in the charge of their own technicians, it is not possible to go into any of the detailed aspects of Technicolor camera operation or maintenance. But at least it can be said that, contrary to earlier opinions, there is very little that can be done with a black and white production camera that has not already been done with the Technicolor three-strip camera. There come to mind many recent productions in which it has been necessary to swing, spin, suspend or submerge a Technicolor camera while shooting.

### Accessories for Technicolor camera

The range and efficiency of the accessories that go with a Technicolor camera are for the most part equal to anything found in black and white practice. Any lens from 25 mm. upwards may be used on the camera, although the wide angle 25 mm. is only chosen when it is absolutely necessary. This is because its performance suffers somewhat owing to the impossibility of designing a distortion-free lens with an effective focus of 25 mm. and a back focus of nearly twice that distance. The introduction of the prism between the shutter and the films making it impossible to employ a normal type of short focus objective.

The Technicolor viewfinding system, whether used with or without the blimp, is



one of the most convenient to be found on any motion picture camera. The viewfinder lens is brought very close to the camera lens, thus reducing parallax to a minimum, and the viewfinder image is directed to the eyes of the operator by reflection from a series of mirrors which remain the same whether the camera is blimped or not.

Any blimp for a three-strip camera is, of course, large and unwieldy, and in the opinion of most technicians the inconvenience of using it represents one of the few remaining objections against the use of the three-strip method.

Until quite recently it has been necessary to use Technicolor cameras either under conditions of daylight, arc-light, or incandescent light corrected by means of bluish filters to produce light of approximately daylight quality. It has also been usual for Technicolor to employ gold as the partially reflecting intersurface of their camera prisms. Gold was originally chosen because it has the useful property of preferentially transmitting green and reflecting red light. With the gold metallised prism and a suitable combination of three emulsions supplied by Eastman Kodak, exposure had been gradually reduced over the years to a key-light requirement of approximately 400 foot-candles at an aperture equivalent to f.2.

### Lowering of Illumination Requirements

But in January, 1951, it was made known that Technicolor, in conjunction with John Arnold, of M.G.M. studios in America, had succeeded in lowering the illumination requirements to the remarkably low key-light level of 150 foot-candles—and that in unfiltered incandescent light!

Before going on to see how this change has been made possible, it is worth while pausing to consider what a revolution it represents in the history of colour photography. Since the earliest days of colour we have heard producers complain that to shoot in colour means an increase of four or five times in lighting costs. Now you can shoot three-strip Technicolor with only twice as much incandescent light as you would expect to use for Plus X on a black and white production. This revo-

lution also means, of course, that many studios that were previously unable to handle Technicolor because they did not have a D.C. supply, can now probably reach the required level with their own lamps.

In describing how this great increase in effective sensitivity has been achieved, one must indulge in a certain amount of what is to be hoped intelligent guessing, since the new technique has never been fully explained by Technicolor themselves.

It seems that three things have been done:

(1) A new combination of three emulsions has been developed by Eastman Kodak; the principal change from the older set being an increase in the speed of the front element of

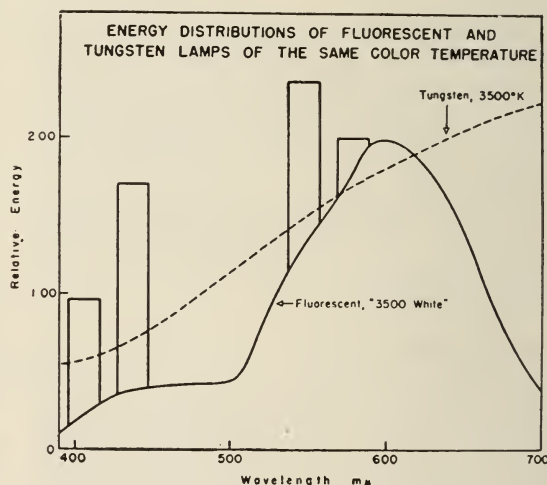


Fig. 1

the bi-pack—that is, in the blue-record. (Once it had been decided to use the camera in unfiltered incandescent light, the speed of the blue-record became the limiting factor. This is easier to appreciate when the relative spectral distribution of incandescent light is compared with that of arc or daylight (Fig. 1).)

(2) As already mentioned, a gold surface reflects a lot of red and transmits a lot of green, but does not reflect blue-light at all efficiently. So a different metal is necessary for the interface of the prism—one that will reflect at least as well at the blue end of the spectrum as it does elsewhere. It is probable



that silver has been chosen because, besides reflecting blue quite well, its overall efficiency is very high—about 94 per cent.

(3) In order to increase the effective speed of the blue-record film still further, it is subjected to a latensification treatment at the laboratory. Finally, the exposed and latensified film is developed in a maximum energy developer.

The idea of latensification is not new, but until a year or two ago it had never been used on a commercial scale in the motion picture industry. According to a paper<sup>1</sup>

certain purposes in black and white work. But when arcs are to be used with the new Technicolor incandescent set-up, they will need to be filtered so that their colour quality matches that of C.P. lamps burning at their rated voltage. This means that in place of the old straw-coloured Y 1 a much denser, pinkish filter must be used.

Pinewood are now making a range of gelatin filters for various production applications and the one they make for correcting high intensity arc light to match C.P. lamps is known as the C.T. orange filter.

One advantage of filtering arcs so that they

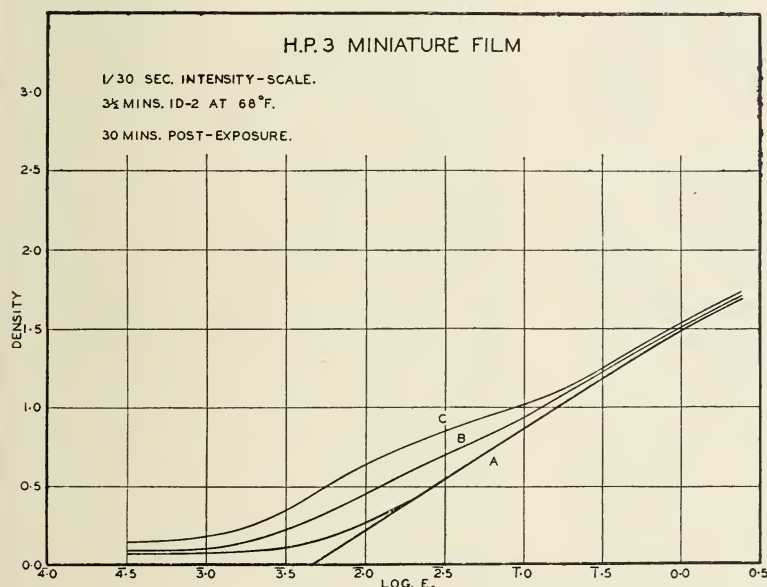


Fig. 2

H.P. 3 film. Latensification by 30 minutes post-exposure of light. A — untreated film, C — exposed to higher intensity fogging exposure than B. 3 1/2 minutes in ID-2.

By courtesy of G. S. Moore and the Royal Photographic Society.

written by G. S. Moore, of Ilford, Ltd., a relatively long exposure is necessary at a light level which will produce about twice the normal fog density after about 30 minutes' exposure. As the intensity of the fogging light is increased, there is a further, preferential increase in effective speed at low densities, with a consequent distortion of density relationships (Fig. 2).

### Filtering Arcs

It should not be thought that because it is now possible to photograph in Technicolor by means of incandescent light alone that high intensity arcs will fall into disuse; after all, quite a few cameramen still use arcs for

can be used in conjunction with incandescent sources, rather than working the other way round as in the past, is that there is less reduction of the total light output of the source. In this connection it is interesting to find<sup>2</sup> that the correction of inky by means of Macbeth "Whiterlite" filters usually results in an increase in colour temperature from 3,350° K. in the case of C.P. bulbs up to a temperature of approximately 6,700° K. Yet lamps that have been so corrected can be used satisfactorily on the same set as 170 type arcs filtered with Y 1's. and having a final colour temperature of about 5,000° K. This apparent contradiction provides a convenient point at which to discuss the colour temperature

measurement as applied to the requirements of colour photography.

### Colour Temperature

The term colour temperature relates only to those light sources which are temperature radiators and which emit their light because of their high temperature. The Pinewood equivalent of the Whiterlite film is their C.T. blue gelatine. Strictly speaking, the sun and the incandescent lamp are the only two such sources in which colour photographers are interested. As the temperature of a tungsten

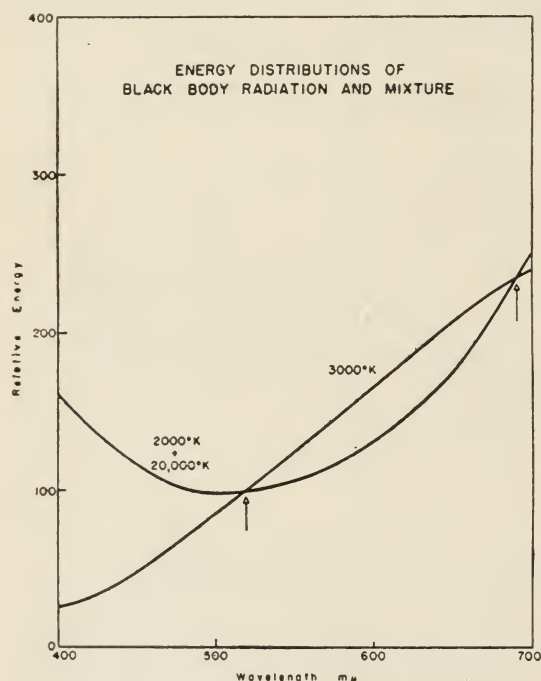


Fig. 3

filament lamp is raised, an increased proportion of its light is radiated in the blue wavelengths and the colour of the light changes from orange through yellow to what we often accept as white. The energy distribution or colour quality of such a lamp can be specified at any point throughout this range by its colour temperature. Furthermore, at any given colour temperature there will always be the same relationship between the light output in any two wavelengths. This fact has

given rise to the design and construction of a number of meters in which colour temperature is measured by a simple comparison of the amount of blue with the amount of red light emitted by any source of the black body type.

However, there are some light sources used for colour photography which do not follow the behaviour of a black body radiator and which cannot, therefore, be said to have any colour temperature at all. Some of the best examples from our point of view will be found under certain conditions of daylight—late afternoon light, for instance—when the direct rays from the sun are mixed with light reflected from a blue sky. Under such circumstances the colour temperature of the sunlight might be as low as 2,000° K, while that of the light from the sky could be as high as 20,000° K. The mixture of these two will result in light which has high proportions of blue and red light, but a deficiency of green. Now, a colour temperature meter based on the measurement of relative energy in the blue and red wavelengths would indicate a colour temperature of about 3,000° K. Yet when the spectral distribution of an incandescent lamp is compared with this kind of daylight, the two will be found to be quite different, and, of course, an unbalanced colour photograph would result from any exposures made at that time of day (Fig. 3).

There is another limitation associated with the use of colour temperature measurements in colour photography. When colour temperature differences are used to describe the properties of correction filters—the Wratten 78 or 86 series, for example—it is found that the Kelvin scale proves rather unsatisfactory, because a filter that changes the colour temperature of an incandescent lamp by, say, 300° K, might only alter the colour temperature of daylight by 100° K. For obvious reasons it would be preferable to have some scale which resulted in any filter having the same value under all conditions.

### New Colour Meter

From all this it can be seen that colour photographers are not primarily concerned with colour temperature, but rather with the

relative distribution of light in the red, green and blue regions of the spectrum. In fact, now that the limitations of colour temperature specification have been realised, a new form of colour meter has been designed in America.<sup>3</sup> The Spectra Three Color Meter (Figs. 4 and 5), as it is called, is used to determine not only the ratio of blue to red light, but also the ratio of blue to green light that is emitted by any source. The Spectra Color Meter is calibrated by means of two scales, in terms of units known as the Spectra Distribution Index, or S.D.I. The S.D.I. of any source of illumination comprises the ratios in which we, as colour photographers, are interested, the blue-red first, followed by the blue-green ratio. If, therefore, the Spectra Sensitivity Index of any colour process is known—and the manufacturers of the meter are publishing ratings based upon practical tests with all the well-known colour materials—then it is possible, whenever the S.S.I. does not match the S.D.I. obtained from the meter, to find by means of a simple calculator what colour correction filter or filters will be required. The Spectra system makes use of six turquoise-coloured filters to raise colour temperature, six salmon-coloured filters to lower it, three greenish filters to increase green and three magenta filters to decrease it.

### Quality of Illumination

A good deal of what has been said on this question of the colour quality of illumination is not quite so important in the case of Technicolor photography as it is with multi-layer colour materials. In order to explain why this is, let us reconsider the case mentioned earlier, where under certain conditions of daylight there may be considerably less green light than the blue-red ratio would suggest. A multi-layer colour film exposed under these conditions would suffer from under-exposure of the green record emulsion layer and the resulting camera negative or reversal positive would be a long way out in colour balance. This error can then only be offset by the introduction of correction filters at a subsequent printing stage. But even supposing that the latitude of the colour film in question per-

mitted the under-exposure of its green sensitive layer without serious loss of shadow gradations, it is never really satisfactory to apply much colour correction by means of filters, since over-correction of low density areas occurs before complete correction of shadow densities is achieved.



Fig. 4. Spectra Three Color Meter, showing Spectra Distribution Index.

But with Technicolor, or, for that matter, with any other three-strip process, the situation is a different one. Provided that the overall exposure has been adequate, the only result of the deficiency in green light will be



a relatively less exposed green record film, which will merely mean that a lower printer



Fig. 5. General view of the Spectra Three Color Meter.

light must be allocated to that record when it is used to print the magenta component image. The particular printer light required for each negative record will be judged from density measurements made on the image of a "lily" or grey-scale photographed at the end of the take under the same lighting conditions. This explains why the inclusion of the "lily" at the end of every scene is of the utmost importance in three-strip processes. More latitude is therefore permissible in the colour quality of illumination used for Technicolor than is the case with monopack materials. However, this does not alter the fact that whatever process is used, the colour quality of the illumination must always be the same over the whole of the field of view, unless, of course, some special effort is being sought and has been worked out beforehand. Local differences due to old lamps, discoloured reflectors and so on will give rise to a patchiness that cannot be corrected by any means at all. This possibility of variation of colour quality within the scene is likely to assume greater importance as more Technicolor productions are photographed by means of incandescent lighting, for we have already seen that a difference of  $100^{\circ}$  K in the colour temperature of an incandescent lamp operating at around  $3,200^{\circ}$  K is far more likely to be noticed than an equivalent colour temperature difference in an H.I. arc operating at more than  $5,000^{\circ}$  K.

**Table I**  
**Colour Temperature Meters available in Great Britain**

NAME OF METER	MANUFACTURER OR DISTRIBUTOR	COMBINED WITH EXPOSURE METER
Ciel	C. L. Thomson, Edinburgh	Yes
Collux III	Milbo Photographic Ltd., London	Yes (Calibrated in Lux)
EEL (Types I & 2)	Evans Electroselenium, Ltd., Harlow, Essex	Yes (In case of Type I)
Kelvilux	Photax, Ltd., London	No
Megatron	Megatron, Ltd., London	No

Colour Temperature Meters

Fortunately, the incandescent lamp can be considered as a black body radiator, and differences between one lamp and another can easily be detected by colour temperature measurements based on blue-red ratios alone. A list of colour temperature meters now obtainable in this country is printed at the foot of the preceding page.

Having dealt with the quality of the light to be used, there remains the consideration of the amount required and the means for measuring that.

The basis of almost all present-day motion picture lighting is the so-called "key-light" technique. The key-light in a scene is generally that light which falls on the face of the principal player or players. Out of doors, the key-light will generally come directly from the sun. All the other lighting in a scene, both the brighter, accent lighting and the shadow lighting, are related to the level of the key-light.

Key-light Level

Since the earliest days of Technicolor the key-light level has been measured by directing the cell of a photo-electric photometer towards the main source of light from the position of the principal centre of interest in the scene. In those early days key-light levels as high as 1,000 foot candles were required, and high intensity arcs provided the only means of obtaining so much light. It was also usual at that time to restrict the ratio of key-light to shadow levels to within about 2:1. But during the past ten years or so this requirement has been more and more fre-

quently disregarded by lighting cameramen who, after gaining their early experience with a restricted lighting range, were not satisfied to continue to work within such narrow limits.

But in this paper there is no necessity to deal with æsthetic questions, other than to mention that queer things can happen with most colour processes if a cameraman becomes careless with the lighting range, and, once again, this warning applies more to the multi-layer processes than it does to the three-strip camera.

Many cameramen already use the incident light method of light measurement for black and white work, and there are a number of meters available that are calibrated in foot-candles. The one used by Technicolor technicians is made by Weston, while Everett Edgumbe also make a suitable instrument with a ten times neutral density filter to increase its effective range. There are also several smaller and cheaper meters that can be adapted for use as incident light meters. Notable among these are the Weston Master with its Invercone, the G.E. Meter with its diffusing attachment, and the new Sixtomat for incident light measurement.

There is one important variable in photographic lighting that incident light measurement does not normally take into account; it is the location of the key-light source in relation to the camera. In the large majority of cases the principal source comes from a position that may vary from directly behind the camera to an angle of about 45° to it. But sometimes by design and sometimes by chance the key-light source may be located

Table II  
Showing approximate lighting required of available colour systems in terms of foot/candles (key light) at f2

	TECHNICOLOR	"MONOPACK"	GEVACOLOR	EASTMAN COLOR NEGATIVE
Daylight or H.I. Arc	300	500	—	300
Incandescent	150	—	500	—



almost at right-angles to the camera axis or it may even go round slightly behind the subject. The incident light reading taken in the direction of the source in all these cases would be the same, but the area of shadow becomes greater as the key-light source gets further round, and in most cases some increase in the indicated exposure will be required in order to avoid an undesirably dark scene.

Several attempts have been made, notably by Norwood<sup>1</sup> in America, to eliminate this difficulty by using a three-dimensional rather than a flat diffuser over the cell of the meter. This modification ensures that less value is attributed to a key-light of a given brightness as its effective contact with the principal subject is reduced. The diffuser of the Norwood meter is hemi-spherical in shape, while the one used with the Weston Master meter is recessed with the same purpose in mind.

But despite all the available means of measurement, even the best photographers occasionally turn in under- or over-exposed scenes. Which leads to the next factor to be considered—the latitude of exposure in colour photography. The oft-repeated statement that there is less latitude possible in colour than in black and white photography has by now come to be accepted. Yet this, like so many other generalisations, needs qualification. Consider a three-plate still colour camera with which one can expose a set of colour negatives at three separate exposure planes. With such a camera it is possible to give as much less or as much more than the optimum exposure as would be possible with a negative intended for black and white printing on a normal grade of paper. In other words, when silver-image separation negatives are made, as, for instance, by successive frame exposures in animation work, there is theoretically no less latitude in colour photography than there is in good quality black and white photography.

However, when we come to consider a three-strip camera we have to make allowances for the fact that two of the three separation negatives are obtained from a bi-pack, and a bi-pack is not a wholly satisfactory form in which to expose two emulsion layers.

In the first place, the emulsion thickness, or coating weight of the front film (*i.e.* the blue-record), must be kept lower than that of a normal film in order to transmit a relatively high proportion of light to the rear record of the bi-pack. It must also be thinly coated in order to minimise the scattering of the transmitted light. These considerations necessarily limit the amount of over-exposure that can be permitted with a Technicolor or any other similar beam-splitting camera.

From experience gained with the Tricolour camera, it seems that under-exposure amounting to half the optimum and over-exposure amounting to twice the correct amount will allow perfectly satisfactory prints to be made by means of printer light adjustments. It is Technicolor's practice to duplicate any negatives which fall outside their printer light range of from 8 to 18, but this may be necessary in order to keep all negatives within a limited density range before making the release matrices, rather than actual inability to obtain a satisfactory colour result from the original negatives.

### Exposure Latitude

Exposure latitude in relation to multi-layer materials presents a different story. It has already been shown why the emulsion layer of the front element of a bi-pack is thinly coated, but, in fact, its coating weight will be at least double that of the equivalent blue-record layer of any monopack. With a three-layer material the dual questions of light transmission and scatter are even more serious than they are in the case of a bi-pack. Furthermore, if there should be any under-exposure of one of the three layers in relation to the others, owing to manufacturing variations or unsuitable colour quality of the exposing light, then the exposure latitude of the monopack as a whole will be reduced still further. The reasons for this are, firstly, that if any one of the three emulsion layers is seriously over- or under-exposed in relation to the others, then either highlight or shadow gradations will be permanently lost to the corresponding component colour image, with consequent distortion of colour rendering in those areas. Secondly, even when the rela-



tive under- or over-exposure is not as great as in the former case, it will nevertheless necessitate the use of a colour correction filter at the printing stage, which in turn brings the problem of sufficiently correcting heavy densities without too seriously colouring the highlights.

These problems of colour correction can also be overcome by making separation negatives from the original multi-layer camera film for subsequent use with one or other of the build-up print processes. In particular, there is the new material known as Eastman Color Negative.

### Differences in Negatives

The principal difference between Eastman Color Negative and other multi-layer colour negatives such as Agfacolor, Gevacolor or AnscoColor, is that it incorporates its own means of forming two distinct masking images at the same time as the colour negative image is being developed. It is now fairly well understood that the best dyes available do not entirely fulfil the theoretical requirements of three-colour photography and the dyes which can be obtained by the process of colour development are sufficiently far removed from perfection to give rise to serious limitations when they are used without some form of compensation for their shortcomings.

Putting it simply, the sole function of each of the three images of a colour negative is to control the transmission of one of the red, green or blue components of the light coming from the subject. In practice, most yellows do their job reasonably well, but the available magentas, besides absorbing green light as they should, also absorb some blue light—which they should not. Also the cyan dyes that can be obtained by colour development absorb undesirable amounts of both blue and green as well as the red light which they are supposed to absorb exclusively.

Now, since the unwanted absorption of blue light by the magenta dye cannot be eliminated, the only thing that can be done is to cancel the adverse effect this spurious absorption will have on any image that is

printed from the negative. To do this, a mask must be used which just counteracts the imagewise effect of the unwanted absorption of blue light. If we were not dealing with an integral tri-pack, it would be a relatively simple matter to produce a silver image positive mask of the required density and contrast on a separate length of film, subsequently printing it in register with the original negative. But with a multi-layer material this is impracticable, so what Eastman Kodak have done is to make the residual colour couplers in the red and green record layers do this job of providing the requisite masks. Instead of putting a colourless magenta forming coupler in the green record layer, they have made the coupler itself yellow in colour, and this colour is only discharged during processing in those areas where there is silver density and where, therefore, magenta dye density is formed. As a result, there exists in effect a uniform low density yellow filter throughout the magenta image layer—partly due to the unchanged yellow-coloured coupler and partly due to the yellow density that is inseparable from the magenta image itself. This uniform layer obliterates the unwanted densities of the magenta image and allows the latter to carry out its proper function of controlling the amount of green light that is transmitted by the colour negative as a whole.

In a similar manner, the effects of unwanted but unavoidable absorption of both blue and green light by the cyan component image are cancelled by the use of an orange-coloured cyan forming coupler (Fig. 6).

There are two ways of using Eastman Color Negative: the first and most direct one is to print it directly on to Eastman Color Print Film. Usually the printing will be done on a rotary printer equipped with some form of colour light change device whereby scene to scene differences in colour balance can be compensated by the introduction of filters.

However, the colour negative can also be used as an original from which to obtain three silver image separation negatives for subsequent use with any of the build-up processes such as Technicolor, Supercinecolor or Tru-

color. Any lack of exposure balance between the image layers can then be remedied, in the first place, by modification of the relative exposures through the tri-colour filters, and in the second place by printer light adjustment during the final printing operations.

While all this might seem to be rather far removed from the everyday problems of exposure for colour, this is really not the case ; for it is most important that neither the

cameraman nor the laboratory technician should be unduly influenced by the apparent simplicity of any method of working in colour. In the end, apart from economic considerations—with which we are not here concerned—the quality of the result on the screen and the degree of consistency with which it can be maintained are the two essentials to the success of any colour process and of any colour cinematographer.

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## BOOK REVIEWS

*Books reviewed may be seen in the Society's Library*

**THE YEAR'S 16mm. FILMS 1950** — *Film User Guide Book 1*, 120 pages, Current Affairs Ltd., 5s.

As there are more than one hundred and twenty firms and organisations distributing 16 mm. films in this country, there has long been a need for a compact catalogue so complete as this.

The book lists all the new films reviewed in the monthly journal *Film User* and released during 1950. It is divided into three main sections: factual films, entertainment films and entertainment shorts. Each entry comprises the title, running time, distributor, producer, sponsor, and names of the principal actors (where these apply), an outline of the content and a brief appraisal of the film and its audience suitability. Further annotations are made for colour, silent films, availability of teaching notes, and absence of hire fee. At the end of the book the address of each distributor is given.

The section devoted to factual films, the longest section, is conveniently sub-divided into subject headings, of which there are more than thirty, and where a film fits into more than one subject category the entry is printed in full under each appropriate heading. In the sections allotted to entertainment films and entertainment shorts the entries are made only once, no attempt being made to group according to subject.

The type faces and paper have been selected to effect a good compromise between bulk and readability, and it is remarkable that so much information has been compressed into a pocketable volume. The spiral wire binding allows the book to remain open at any chosen page, but the use of binding tape to cover the wire has a somewhat amateurish look.

Those who refer to this guide for reviews of the entertainment films listed (which also include National Film Library subjects of earlier days) may be disappointed in some of the entries, which occasionally give little idea of the story and sometimes even less idea of the reviewer's opinion of the picture. It is, however, in the field of the factual film that the book will be of the greatest value. The generous allowance of headings enables one to locate all the related productions of the year with ease, and the reviews are of the succinct quality familiar to readers of *Film User*. Unreserved agreement with every review is hardly to be expected, but there is no doubt of their sincerity and impartiality, and the assessments of audience suitability should prove particularly useful.

This handy book of reference should be invaluable to film societies, schools, staff training establishments and, indeed, any who make good use of the 16 mm. projector. The one note of regret is that its appearance is so belated. It is to be hoped that the publishers may be able to produce future editions nearer to the end of the year concerned.

P. W. DENNIS.

**A PICTORIAL HISTORY OF THE MOVIES**, by Deems Taylor, George Allen and Unwin Ltd., 375 pages, 25s.

This is a revised edition of a book first published in America in 1943. The descriptive notes on the jacket inform the would-be reader that it contains over seven hundred select pictures telling the story of the movies ; but it would be more accurate if it had stated of *American* movies. Tracing in pictures the history of the kinema from Edison's Kinetoscope of 1889 to R.K.O.'s "The Widow" and Screen Play's "Home of the Brave" (1949),

the author omits to mention William Friese-Greene, R. W. Paul, Barker, Hepworth, Pearson, Korda, Balcon or, indeed, any British contribution to the progress of the art. Mention of "Hamlet" and "Henry V" seem to be the only concession to the existence of any British films. The evolution of the documentary film is credited to Merian C. Cooper with his film "Grass" in 1925, but no mention is made of Ponting's "The Great White South" in 1914 (the film of the Scott Expedition), or the later British efforts in this field by Bruce Woolfe, Grierson, Summers and others.

Nevertheless, accepting the volume as a record of American progress, it has a fascinating and somewhat nostalgic appeal. B.K.S. members will be interested in the many production and studio photographs, showing Billy Bitzer and other pioneer lighting cameramen cranking their early Pathé and Bell-Howell cameras. **BAYNHAM HONRI.**

**THE PROFESSIONAL TRAINING OF FILM TECHNICIANS**, Jean Lods, *A U.N.E.S.C.O. Publication*, H.M.S.O., 155 pages, 6s.

This book was sponsored by the United Nations Educational, Scientific and Cultural Organisation, and is a survey of the facilities found in various countries for training all types of film technicians. It is written in five chapters, which give a general survey of professional training, describe present practice of training instituted in various countries

and stress the value of the short film as a training medium. They list the schools and institutes and give the syllabus employed by them. The final chapter compares the composition of the film units in use in various countries, details their composition from the Producer downwards, and describes quite fully their qualifications, duties and, in some cases, salaries.

The book gives a very full account of what is done in France and some other Latin countries, but a description of the facilities in English-speaking countries does not appear to be quite so complete. For example, the only reference to educational activities of any description in England appears to be a brief mention of our documentary films in the chapter on the short film, whereas the activities in France are described in detail, even to how the many film clubs operate.

Reading this book makes it difficult to escape from the conclusion that the facilities for organised education in England are not as good as in other comparable countries, even although allowance has been made for the omissions. Reading the book without making such allowances, however, does produce a rather misleading impression.

The book is about the education of technicians employed in film studios; those concerned with projection in the kinema are mentioned only when they are employed directly in film production.

**F. S. HAWKINS.**

## THE COUNCIL

*Summary of the meeting held on Wednesday, February 6, 1952, at 117, Piccadilly, London, W. 1.*

**Present** : Mr. L. Knopp (*President*) in the Chair, and Messrs. B. Honri (*Vice-President*), H. S. Hind (*Deputy Vice-President*), A. W. Watkins (*Past President*), R. J. T. Brown (*Hon. Secretary*), N. Leever (*Hon. Treasurer*), D. F. Cantlay, F. G. Gunn, F. S. Hawkins, T. W. Howard, E. Oram, R. E. Pulman and S. A. Stevens.

**In attendance** : Miss J. Poynton (*Secretary*).

### COMMITTEE REPORTS

**Membership Committee.**—The following are elected:

Timothy Peter Hadingham (Member), Stanley Schofield, 11, Grape Street, London, W.C.2.  
Leslie Dawson (Member), Film Unit, Telecommunication Research Establishment, Great Malvern, Worcs.

The following transfers from Associateship to Membership are approved:

Norman Nixon, Troxy Cinema, Commercial Road, London, E.1.

Henry Frederick Knights Blake, Ritz Cinema, Aldershot, Hampshire.

The following transfer from Studentship to Associateship is approved:

Russell Edmund Hill, Theatre Publicity, Ltd., 142-150, Wardour Street, London, W.1.

The resignations of two Members, six Associates and one student, and the death of one Member are noted with regret.—*Report received and adopted.*

**Theatre Division.**—The Council has reappointed Mr. S. A. Stevens Chairman of the Divisional Committee, and Messrs. L. A. Blay, R. E. Pulman and S. B. Swinger are reappointed to the Committee.

**Film Production Division.**—The Council has reappointed Mr. Baynham Honri Chairman of the Divisional Committee. Mr. C. W. Crowhurst is reappointed, and Messrs. G. Craig and W. S. Bland are appointed to the Committee.

**16 mm. Film Division.**—The Council has reappointed Dr. D. Ward Chairman of the Divisional Committee. Mr. H. S. Hind is reappointed and Mr. D. F. Cantlay is appointed to the Committee.

**Projectionists' Apprenticeship Scheme Committee.**—Dr. F. S. Hawkins is appointed Chairman of the Committee.

The terms of reference are:

"To prepare a national syllabus for the training of apprentice projectionists."—*Report received and adopted.*



*Publications Committee.*—The Course of Lectures arranged by the Tele-Kine Group, "Television in the Kinema," and the Course of Lectures on "Sensitometry" will be published in due course.—*Report received and adopted.*

*Library Committee.*—A scheme to enable students undergoing an approved training to join the Society and borrow books from the Library is approved.—*Report received and adopted.*

The proceedings then terminated.

### SOCIETY DINNER

Owing to the King's death, the Dinner arranged for April 8 has been cancelled.

### PHYSICAL SOCIETY EXHIBITION

It is interesting to note that among exhibits at this year's Physical Society Exhibition are the "EEL" Flame Photometer and the "EEL" Colour Temperature Meter, both manufactured by Evans Electro Selenium, Ltd.

### PERSONAL NEWS OF MEMBERS

Members are urged to keep their fellow members conversant of their activities through the medium of *British Kinematography*.

WALTER BUCKSTONE recently read a paper to the Medical Group of the Royal Photographic Society on the history of cinematography and the making of the first 16 mm. medical sound film, for which he was responsible.

H. S. HIND has been elected a Fellow of the Royal Photographic Society.

A. A. ENGLANDER is now director/cameraman in charge of production of the Ministry of Works Film Unit.

H. E. DRISCOLL is a director of Walturdaw Cinema Supplies (1952), Ltd.

ERNEST TAYLOR, director of make-up departments at Ealing Studios, is leaving shortly for Southern Rhodesia.

### SITUATION VACANT

Old-established manufacturers of sub-standard cinematograph apparatus have vacancy for a capable qualified technician with full experience in all its branches as Control assistant for general production of such equipment.

Applicants between the ages of 25 to 35 years need only apply, stating experience, qualifications and salary required to Box No. 4921, The British Kinematograph Society, 117, Piccadilly, London, W.1.

Small announcements will be accepted from Members and Associates. Rate, 4d. per word, plus 2s. for Box No. if required (except for Situations Wanted). Trade advertisements, other than Situations Vacant, not accepted.



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# BRITISH KINEMATOGRAPHY

VOLUME 20, No. 4

APRIL, 1952

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## BRANCHES COMMITTEE

THE Branches are an important source of life to the Society, and it is hoped that one day these will thrive throughout the country, and indeed throughout the world.

At present, there are three Sections, Leeds, Manchester and Newcastle. In the course of time and in accordance with the Constitution, these will qualify as Branches. As conditions within the industry improve, it is hoped that an ever-increasing membership among technicians working outside the London area will create a demand for the formation of more Sections.

The organisation and maintenance of Sectional activities demands a large measure of patience and determination. The Society's staff provides the help which lies within its power, but this must necessarily be indirect help and the efforts of the minority of members who give freely of their time and experience for the benefit of their fellows, must be relied upon.

A debt of gratitude is owed to the Section Committees, and in particular to the Hon. Secretaries of the three Sections for the burden which they carry in this respect.

There are many hundreds of technicians outside the London area whose need for technical information can be served through membership of the B.K.S. An even greater need can be served by the eventual establishment of branches in various territories, when organised activity will afford a means of meeting for discussion or to hear papers prepared by specialists, or for ordinary social intercourse.

The formation of a Section is quite difficult to accomplish. In considering such formation, the Council is guided by the membership figures and other potentialities of the territory. A careful examination is made of the factors considered necessary for successful operation.

R. E. PULMAN.

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## MAGNETIC RECORDING — A PROGRESS REPORT

W. H. Clarke, O.B.E.\*

*Read to a meeting of the Film Production Division on January 16, 1952.*

THE facilities and equipment shortly to be made available to motion picture production studios to record and reproduce sound, in synchronism with picture, on perforated magnetic film, will be described.

Several qualified members of the British Kinematograph Society have covered the history and technical development of the art of recording sounds by varying the state of magnetic fields along wires and support material coated with ferrous powders.<sup>1-6</sup> We may, therefore, examine the tools developed to use the material most suited to the film industry, the new tools which are being manufactured for this industry, the reason for their introduction, and the benefits to be derived from this alternative to the established photographic method for selected sequences of production recording.

At the present time it should be understood that records for magnetic film do not easily fit into every phase of production and it will be appreciated that for the immediate future at least, photographic sound on film is of greater convenience and economy than its new counterpart in certain operations.

### Replacing of Photographic Emulsions

There seems little doubt, however, that as more and more magnetic equipment goes into studio service and experience is gained by constant use, the magnetic material may ultimately become a standard and may completely replace photographic emulsions until the final sound negative stage is reached. Even the final sound negative can be considered just outside the domestic operation because it will in most cases be an electrical transfer from a 35 mm. magnetic film on which the final mix has been recorded. It would of course, be possible to eliminate a photographic negative by introducing what may be termed an electronic printer into pro-

cess laboratories whereby a positive type soundtrack would be photographed on the release print by a light modulator actuated by the signals produced by a magnetic head scanning the master magnetic record. Such a scheme has many virtues in preserving the sound quality finally reaching the theatre audience.

### Use of Magnetic Recording in Kinemas

Alternatively, it may some day be considered desirable to apply a stripe of ferrous material down one side of the release print, in which case the theatre equipment would reproduce with a magnetic pick-up the magnetic soundtrack (electrically transferred from the magnetic master again made by the electronic printer). In practice, however, there is probably no case for 35 mm. theatres to invest in conversion kits merely to provide another way of reproducing 35 mm. soundfilms. What, therefore, are the basic reasons which have caused such interest in magnetic recording? The interest is certainly not confined to motion pictures, but has entered every field employing recording methods; gramophone companies now make their original recordings on magnetic tape; broadcasters make transcriptions on tape; package programmes are sent forward on tape; public address systems and like services use tape. It is used for office dictation as a rival to the wax cylinder, and is even released as a flimsy for reproducing on gramophone record turntables. In the motion picture field the reason is undoubtedly the reduction of production costs. In some other industries the reason is cost reduction, longer playing time and improved quality. Without the economy angle, any case put forward to show the method would give better quality in motion pictures, would have academic interest only.

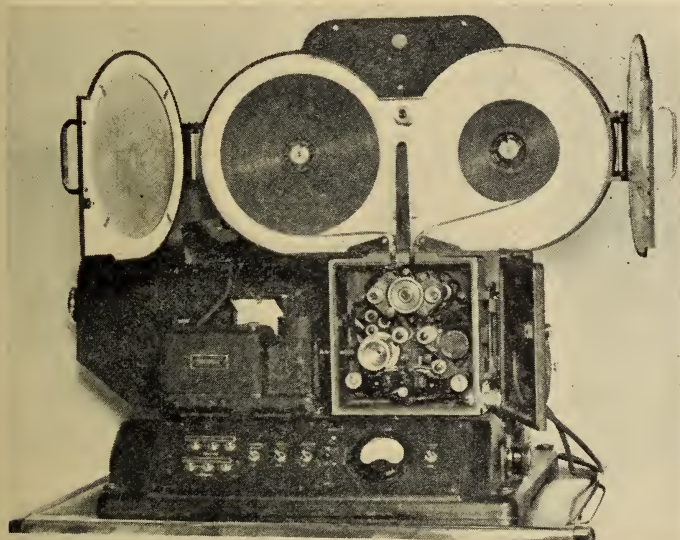
\* RCA Photophone, Ltd.



### Quality of Photographic and Magnetic Recording

The opinion was expressed in Hollywood during the Spring of last year by an experienced engineer, that for quality there was very little to choose between Class B push pull photographic and magnetic recordings, but in spite of this they would plan to install magnetic equipment to augment their relatively new and modern photographic plant because the potential savings could simply not be ignored. These basic savings are almost wholly related to the purchase of sound recording stock, processing charges on this material, storage space and time. There are many plans produced to show how the

studio and location, and the daily transfer of the chosen takes to photographic film for editing room use. This original recording is usually made on 17½ mm. magnetic film running at forty-five feet per minute, which reduces the capital investment in magnetic stock, but still provides adequate quality. The introduction of the new speed could be a complication if complete transfer was not intended. Phonographs are not necessary to handle the transfer of this narrow gauge and at this half speed because the new recorders all incorporate recording and reproducing facilities and this design feature is incorporated in both the portable and static



*Fig. 1.*

*Type PR.23 photo-magnetic recorder fitted with LMI.68 magazine.*

economy may best be achieved—they vary quite widely in some respects and it will require time before they crystallise into a close common pattern.

In Hollywood there is common agreement however in many respects and within the current year it is expected that every major production studio will have standardised magnetic film for all original recording. Even as early as the beginning of 1951 one major group had turned over to magnetic film completely and were announcing a considerable saving per production. The general tendency however, is towards the introduction of magnetic film for original recording, both

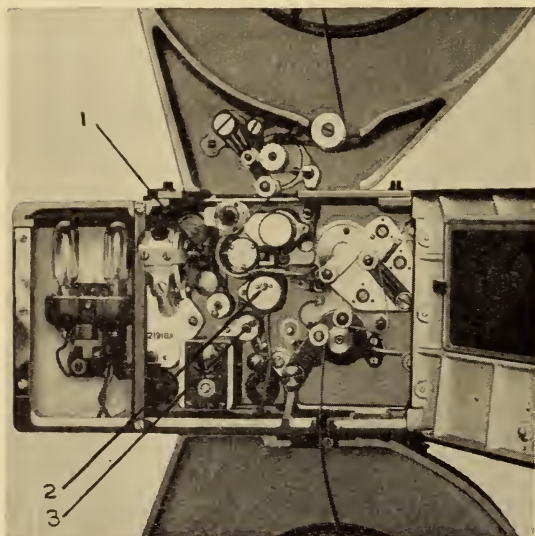
channels. Some thought is being given to the form the photographic track shall take at transfer, a normal negative-print combination, or a direct positive, to which a protective coating can be applied to avoid damage in cutting so that the print may be used again in re-recording.

For music recording, post-synchronisation, re-recording, etc., 35 mm. film moving at the standard speed of 90 ft. per min. is employed enabling happy intermingling of both photographic and magnetic film without complication. The field test phase of magnetic recording is completed, its value to the motion picture industry has been proved and

a distinctive range of equipment is becoming available. In this country interest in the new technique is growing rapidly and it would have been more advanced if the unsettled condition of the industry had shown some improvement during the last year or so.

### Conversion of Equipment

The first equipments have been in use since about August of last year and consist of conversions of the standard RCA photographic channels. The conversions are for the present all applicable to the model



*Fig. 2. LMI 9031 reproducer head for magnetic and photographic track, showing (1) optical assembly for photographic track, (2) magnetic play-back head, and (3) retractable carriage.*

PR.23 recorder (Fig. 1) and 9031 series soundhead (Fig. 2) whether used as a film phonograph or in combination with a picture projector. After conversion, the assemblies become dual purpose and retain all the features and performance for photographic recording as originally designed.

The conversion features are of some interest and as far as possible, without making a Christmas tree of the machine, attempt to include all the essential functions required by production personnel.

It will be recalled that in the past all RCA film movements for both recording

and reproduction embodied a soft loop film path, whereby in the recorder the film at the time of passing the exposure point was isolated from mechanical disturbance due to sprocket wheels and the associated drive members and any irregularity caused by engagement of the film over the sprocket teeth. Such a method of film traction is not at all suitable for magnetic recording as now the recording and monitoring heads must be in close contact with the active surface of the magnetic film. The first change therefore, is a remodelling of the film path so that additional plain and loaded rollers are introduced before and after the recording drum. The geometry of the new path may be clearly seen in Fig. 3.

### Off Drum Recording and Scanning

In revising the film path to a tight loop arrangement, a square housing was introduced to provide additional space for the various units. This new film path gives a satisfactory film movement and has proven as good and stable as the soft loop when recording on either photographic or magnetic film. Two magnetic heads are mounted in the bottom part of the housing on a retractable carriage. Looking at the machine from the operating side the recording head is on the left and the monitor head on the right. The recording head is mounted so that its gap shall be as close to the outgoing side of the recording drum as possible. In this position excellent performance is achieved and of course there is flexibility in meeting any track position standard. This method of mounting is commonly termed "off drum recording and scanning."

The alternative mounting, used in some of our equipments whereby the head is placed in the recording drum, is called "inside drum recording and scanning."

### Flutter Readings

In general, RCA prefer the off drum scan position because of the greater flexibility available. The overall flutter readings for this recorder movement using off drum



scan are of the order of 0.05% and are well within the tolerance set up by the American Academy. To record photographically it is simply necessary to lower the retractable carriage to allow free passage of the photographic film.

When the carriage is in the upper position, both magnetic heads press against the film and are found to require no further adjustment as wear on the head cores takes place. Mu metal shields are fitted snugly over the heads to prevent spurious pick-up from external fields.

#### The Conversion Kits

The conversion kit includes a special film magazine fitted with motor take-up in either direction, and doors with transparent windows, as the standard film magazine does not readily adapt itself for the functional operations of reverse drive, backing up for replay, or rapid loading.

Standard two inch cores are used and the capacity of this model is 1,000 feet. The rewinding of a full reel takes about one minute in either direction and a trip switch is provided to cut power at the end of the operation. Electrical circuits are brought down to the recorder control panel by means of a multi-core cable and plug. Standard photographic magazines and this special magnetic film magazine are readily interchangeable and no interference takes place with the magazine take-up clutch and belt assembly normally fitted to the recorder.

In certain cases it is found advisable that both a synchronous running and interlock drive should be provided and although not part of the kit, such a facility can be fitted to this recorder. Contained in a single housing are separate selsyn and synchronous motors which engage a common driving shaft.

The conversion is completed by supplying two small amplifiers, which may be rack, wall or shelf mounted. The first of these items contains the bias oscillator which provides sufficient current at between 60 and 70 kc. to reach the optimum bias conditions for magnetic film now in use. The waveform of the oscillator is of importance. The

bias oscillator incorporates switching arrangements for passing the output signal of the main recording amplifier to either the magnetic head or light modulator. The second amplifier provides gain for feeding the signal from the reproducing monitor head and also includes a correction network.

It is not always desirable to use the recorder mechanism for transferring the recordings made on magnetic film to photographic film and there is a complementary conversion kit, which can be fitted to the standard RCA rotary stabiliser soundhead.

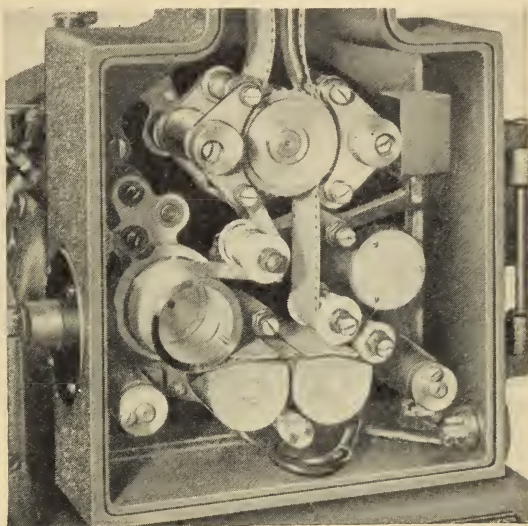


Fig. 3. A view of the internal assembly of the dual-purpose recorder.

As for the recorder, the soft loop film path must be changed to the tight loop arrangement and this can be done while still allowing adequate space for threading the machine. The soundhead after conversion has dual operating features as in the recorder, and the performance from photographic film is in no way impaired by the change. Naturally, only one magnetic head is fitted in this case and again it is mounted on a retractable carriage which, when in the upper position, engages against the active surface of the magnetic film closely adjacent to the scanning drum. The kit includes a suitable pre-amplifier and correction network and may be wall mounted within reasonable



distance of the soundhead. The heaters of this amplifier are energised from the exciter lamp supply unit already associated with the existing plant while anode voltage may be from one of the units already supplying early apparatus. Both L.T. and H.T. demands are small. As in the recorder movement, loaded rollers are fitted before and after the scanning drum. When the soundhead is mounted with a projector mechanism, a modified movement is provided which has a similar order of performance.

These two complementary conversions are able to give the majority of benefits to studios with the minimum capital outlay and with these assemblies original recording, post-

therefore of the safety type in keeping with present trends.

#### Erasing of Used Film

With regard to the erasing of used film, a place is provided in the recorder housing for mounting an erase head which could be used to wipe all or part of a recording. This head has been eliminated because of the chances of its accidental use and all erasing is now done on a completely separate unit.

It is RCA's plan to follow these photo/magnetic conversions with new equipments designed only for magnetic recording and reproducing. Firstly, we shall consider the functional features of the portable units

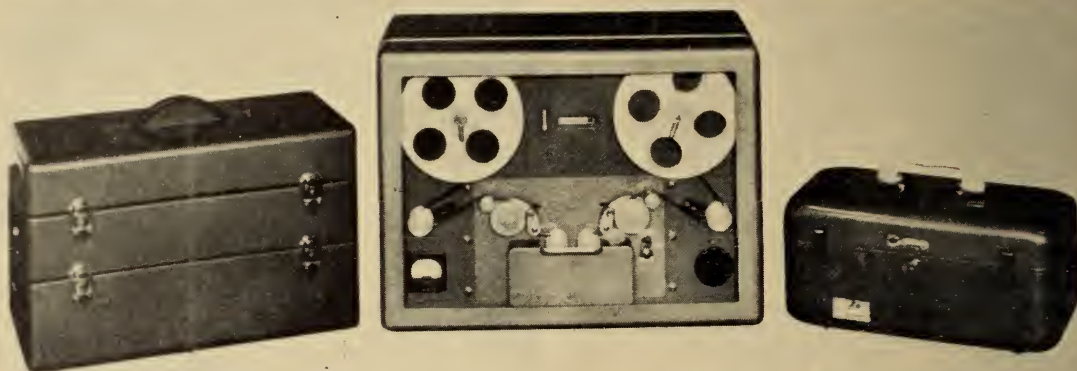


Fig. 4. Type PM.64 portable magnetic recording equipment, showing (left to right) MI.10279 mixed amplifier, PR.42 magnetic recorder, and MI.10521 portable AC power supply.

synchronising, transfers, review and re-recording, either at base or on location, may be readily carried out with full assurance of both quality and synchronism.

#### Availability of Perforated Magnetic Film

Equipment as described has been in operation at the RCA service studio for the past two years and the several studios now similarly fitted are obtaining very satisfactory technical and monetary results. Adequate supplies of suitable perforated magnetic film are now available in London. The prototype equipment was developed to use stock made in the United States but the performance of the local stock is almost a replica of the American product. The iron oxide is coated on an acetate support base and the film is

which are again designed to make use of perforated film. There are two models known as the PM.62 and PM.64—the latter model being the most recent development and weighing less than half the PM.62. The PM.62 comprises four cases and can be supplied for use with 35 mm. or 16 mm. film. It can incorporate several types of motor drive as for example Multi Duty, which is a DC/AC unit most suitable for locations, Three Phase Synchronous, Selsyn Interlock, Single Phase Synchronous, or a dual purpose unit which provides sync/selsyn alternatives by choice of switching.

Another useful feature is that it may readily be removed from its case and mounted on a standard relay rack for mobile or studio use. It has a film capacity of 1,000

feet and embodies a footage counter operative in either direction of film travel, suitable film backing up and fast rewind facilities. There are two recording drums, each having a magnetic head closely adjacent and the unit uses off-drum scanning. The complete channel weighs some 300 pounds.

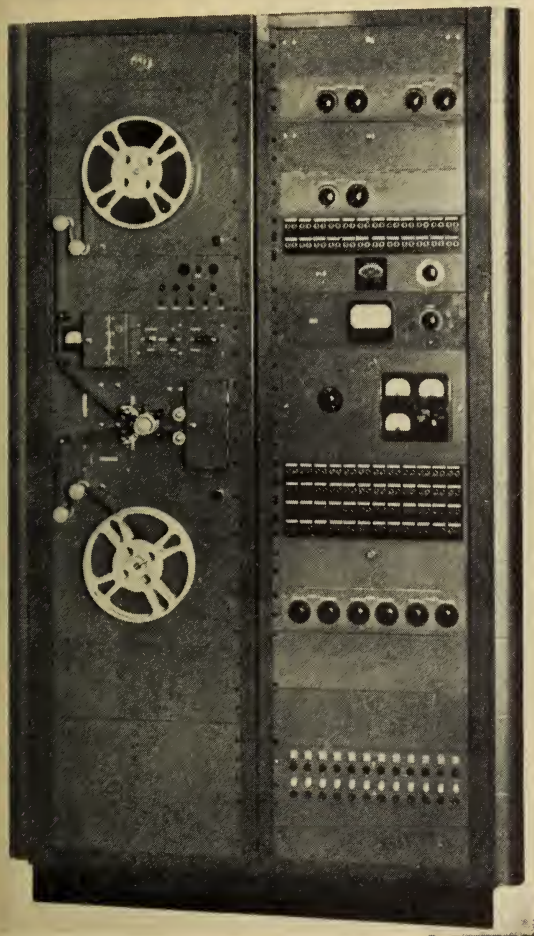


Fig. 5. PM.63 three track magnetic recording equipment, threaded to record or playback without erasing.

#### A Smaller Unit

The PM.64 (Fig. 4) is a much smaller version which is finding great favour in Hollywood. Where minimum weight is desirable it is very satisfactory. Again the recorder uses perforated film in either the 35 mm. or 17½ mm. gauges. It includes two recording drums, off-drum scanning, forward and re-

verse counters and fast rewind and film back up facilities. The channel is made up of three cases—the mixer amplifier weighing some 28 pounds, the amplifier power supply unit weighing some 30 pounds, and the recorder complete weighing some 65 pounds. The film capacity is 500 feet with the transparent front door closed and 1,000 feet with the door removed. To use the larger reels the film centre spindles are pushed outwards and upwards to allow the spools to clear the film path assemblies. The bias amplifier and the pre-amplifier in this model are both mounted in the recorder itself so that the rest of the necessary amplification and power is housed in the mixer. Both these models are supplied as standard for two microphone mixing.

#### Triple Track Recording and Reproducing Assembly

The next equipment we shall make available here is a Triple Track recording and reproducing assembly. This is designed for studio use and will use 35 mm. magnetic film travelling at the standard motion picture speed of 90 ft. per min. The Triple Track model is known as PM.63 (Fig. 5) and is installed on two relay racks. The motor drive will usually be dual purpose—sync/selsyn or just selsyn, as most of its work will probably be in connection with final mixing, music recording, post-synchronising, foreign versions, and the like.

On the left hand panels reading from top to bottom, are seen the feed in film spool, triple erase heads and associated controls, film drive and two triple cluster recording and reproducing assemblies and finally, the film take up reel.

On the right hand panels are the amplifier units, gain controls, patch bay and test equipment. This is the only equipment to be fitted with erasing facilities and to avoid accidental erasure three distinct paths are provided for the film. The main functions of this channel are the recording of from one to three separate sound records across the active surface of a 35 mm. film. These multiple tracks may be simultaneous—comprising say the principal tracks of a re-



recording or three sections of a musical number etc., or they can be single recordings where each adjacent track runs in the opposite direction, or any form of recording or reproducing requiring segregation, as for example, the preparation of foreign versions. Any of the tracks may be erased singly, and any track may be recorded or reproduced singly. Recordings may be made in either direction of film travel and complete monitoring facilities are provided for each track. The recording and reproducing heads are identical assemblies mounted side by side in mountings which can be readily detached for replacement or servicing. Adjustments of these heads are never made in the field but on calibrated plates in association with a tool maker's microscope. This method has proved so accurate and consistent that replacement assemblies can be put into immediate service with confidence. Unit heads are never replaced in a cluster and no salvage is attempted when the assembly is taken out of service. The life of all current magnetic heads is, of course, governed by the wear of the film abrasive which in turn can usually be related to the footage passed through the machine. These heads are each 0.875 in. in diameter and 0.300 in. thick. Whether for single or triple track use, the core width is 200 mils. for recordings made on 35 mm. or 17½ mm. film.

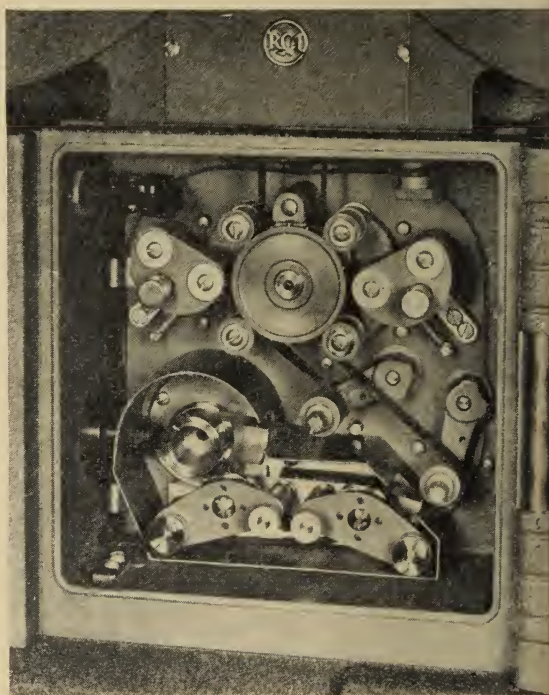
A new feature used on this equipment is that the main film driving sprocket may be disengaged while the motors are running, allowing the operator to adjust synchronism without closing down. This triple track channel is the only rack type to be manufactured in London although a variety of rack units are being produced in Hollywood to cater for various gauges of film, film speeds, and motor drive.

#### **New 16mm. Magnetic Sound Projector**

Although not forming part of the manufacturing schedule in London, RCA's recent development for the 16 mm. field will have great interest for many users of this gauge film. This is the RCA type 400 magnetic sound projector which is just going

onto the American market at a price of some £300. The projector is slightly larger than the usual 16 mm. soundfilm unit but it provides facilities for the reproduction of standard photographic 16 mm. soundfilm, the reproduction of 16 mm. film which has sound magnetically recorded on a stripe of oxide located on the edge of the film and it also provides facilities to make these recordings including the erasing when necessary (Fig. 6).

The quality obtainable from the magnetic



*Fig. 6. MI.10322 AM 16mm. recorder, showing the film path for magnetic film.*

stripe is outstanding and can be considered only slightly inferior to sound records reproduced from the average release film in theatres. The stripe may be 100 mils. wide or, alternatively, 50 mils. so that in the latter case either the photographic or magnetic record may be chosen by the turn of a switch. The response is flat between 80 and 7200 cycles with a dynamic range of approximately 45 db. It is expected to find many applications in films designed for sales, advertising, teaching, training and foreign ver-



sions of feature subjects. The cost of producing sound with this multi use equipment, has been estimated to be about one third of the cost of achieving comparable results

photographically.

*Mr. Clarke then reproduced some magnetic recordings made on a converted PR.23 recorder.*

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## DISCUSSION

Mr. B. HONRI: You seemed to indicate that Class B push-pull was the finest photographic track, possibly owing to the absence of clipping by ground noise reduction shutters. What about using magnetic track as a means of making the ground noise reduction shutter open in anticipation of modulation? This would enable magnetic recording to be transferred to Class A photographic track without distortion due to such clipping.

THE AUTHOR: I chose Class B because of its good dynamic range and the absence of shutters. It is the tendency at present to employ the anticipating shutter arrangement to avoid the distortion inherent with currently used optical systems. This system preserves the full quality of the magnetic recording and is easier to handle than Class B.

Mr. R. H. CRICKS: One thing I find rather disturbing is the variety of standards being introduced. We have speeds of 15 ins.,  $7\frac{1}{2}$  ins. and  $3\frac{3}{4}$  ins. per second on tape, and 90 and 45 feet per minute on film; we have 35 mm., 17.5 mm. and 16 mm. film, the first with one, two or three tracks; we have track width of 100 and 200 mils. Is this multiplicity of standards unavoidable?

THE AUTHOR: I do admit it starts to become frightening, but looking through it all I would think that probably the other speeds, apart from standard speeds, will not come into universal usage. In fact, I am not content to think that the introducing of secondary speeds is a distinct advantage. I would prefer to think that probably in the early enthusiasm of trying to make the maximum economy, you had someone saying that if the gauge of the film was halved, theoretically the cost would be halved. If we halve the speed we make another gain; we will have a film which is only going to cost a little money. But the introduction of the secondary speed to achieve

that purpose can be dangerous. If you keep to an immediate transfer and get back on to your standard speed all may be well, but that is rather wishful thinking. I feel I should use a 35 mm. film as is practice, take the maximum economy from it by thinking out ways and means of not cutting or damaging that film. So preserved, it is almost non-consumable. Yet a method of transferring to photographic would be your least expense. These economies must be approached in stages instead of going all out in the beginning. The same thing can be said for all the different track widths and positions. I hope that either the proposed Academy standard for triple tracks, which is now not a standard but is very close to being one, will come into being. There is a lot of logic in it: that the three tracks be called 1, 2 and 3. They have a space between the tracks which gives a loss of not less than 50 db, and that by maintaining the required distance between tracks still does not bring the two edge tracks near enough to the sprocket holes to get any serious disturbance from the sprockets themselves. That gives us three positions of track for multi-track working. The No. 1 position of the three is proposed as the standard for single track working. In 17.5 mm. the same track position is proposed to be maintained and in each case the track width will be 200 mils. It deviates and goes down to 100 mils. for 16 mm. only.

Mr. N. LEEVERS: I submit the greatest advantage of magnetic recording is the certainty of results and not the cost savings.

THE AUTHOR: There is no doubt of the considerable help to production personnel of knowing the quality of the film. It will in general improve the average quality of future films, but there is no doubt that without the economy angle production groups would have given the new technique no more than passing interest.

## THE USE OF THE TRAINING FILM BY M.S.A.

F. R. King, M.B.E. (Member)\*

*Read to a meeting of the British Kinematograph Society on February 6, 1952*

THE Marshall Plan has been widely publicised during the last four years, but few people know just what that Plan was, and how it worked. Briefly, it was an American Plan to assist Europe to recover economically after the war, by providing much-needed finance and technical assistance. In order to see that this great effort on the part of the American taxpayer was not wasted, the U.S. Government set up an organisation to administer the grants and to give European countries advice and assistance on how to make best use of the Plan. This organization was the Economic Cooperation Administration, or E.C.A. for short.

### The Mutual Security Agency

The U.S. Government has now remodelled E.C.A. into the Mutual Security Agency, one of whose main efforts will continue to be to assist European industry and agriculture to raise its productivity rate, *i.e.*, produce more with less effort and thereby lower prices and increase employment and achieve a higher living standard. Thus, on January 1 this year, E.C.A. became M.S.A.

The job of the M.S.A. section where I work is to increase the use of films to speed good ideas, new techniques of work, knowledge of good and faster farming or industrial practices. To show people why and how to do the job better, quicker, more easily, more effectively.

The subject is not a new one. Films have been used for training in different parts of the world for a long time but so far the various groups doing the work have not combined their efforts. There has been some co-ordination in the United States where there are University courses for management-training and where technological training of

the man on the job is the active concern of Unions and Industrialists alike.

All over the world, too, the fighting services have long used the film to train their officers and men and they have evolved film formulæ to meet their particular problems.

In Britain and in other European countries, the immediate post-war emphasis was placed on classroom teaching films. There would have been nothing wrong with that if it was a question of limited resources being used to achieve one goal at a time. However, very little overall thinking was devoted to this question and neither industry nor agriculture was so organized that the full use of film could be made by tackling the general problem of post-war development. Perhaps we were also blameworthy in that film-men who saw the possibilities of training-films did not attack this problem in a single-minded fashion either.

Whatever the cause, the net result to-day is a complete lack of up-to-date training-films for adult use in Europe. To see how true this is, requires only the briefest of surveys of the lists and catalogues issued in the capitals of Europe. Compared to the needs of the thousands of different industries, the hundreds of different aspects of agriculture, and the many, many research establishments and technical training institutes of all kinds, the films available are a drop in the ocean.

Additionally, Europe is a huge and diverse body with interests and needs as distinct from each other as a remote Turkish farm is from a steel mill in Sheffield. The problem of any form of co-ordination is enormous. The inevitable difficulties of ten distinct languages with great dialectical differences within themselves, the problems of transport, customs barriers and even such basic common denominators as the problem of electrical

\* Mutual Security Agency.

supply, have also to be considered. It will be seen that there can be no simple formula to work on.

Pictures are a powerful weapon. They hit hard at the mind and stick in the memory better than words. The film affects thinking more easily and more rapidly than the written word. This function of films to act as a mental stimulant is probably the most important result of the invention of motion pictures.

### The European Position

The field that needs to be covered is so vast that no one organization could hope to do the job alone, even if it wished to try. Europe is made up of many thousands of groups of people doing many thousands of different things and doing them in many different ways in different parts of the continent. Conditions vary from one part of Europe to another, they even vary from town to town and within towns the mental attitude varies from one man to the next.

I will just illustrate one aspect of the field to show how great the divergence can be. The following extracts are the literal translations of a tape-recording made after an experimental showing of films on farming methods to a Turkish village audience.

Here are some of the recorded questions and answers after a showing of a film on Poultry Raising, another on Cattle Farming and one on the need for drinking water to be clean:

Q. Someone was talking during the film. Do you know who it was? Was he someone whom you saw in the film?

A. I don't know. He explained that things would happen and they happened. I heard the voice, but I could not understand where it came from.

Q. Did you understand what he explained?

A. No, I could not follow him. I cannot follow him when looking at the picture.

There the first fundamental problem is encountered. To what extent can people follow sound and picture at the same time—is there an intelligence level at which they can do this?

Q. Will you tell me what you understood?

A. They clean all the animals. All is well. But I cannot remember. Being peasants we cannot keep it in mind. They get the milk, take the car and go.

Q. Where did they take the animals?

A. I don't know, they come until here (indicating the edge of the screen with his finger), and then at the edge disappear. They go into darkness.

Q. Are these animals real, then, or are they pictures?

A. (Pause.) I never saw such a thing before. I saw many things in the army, but never like this. Cars come, everything comes, but . . . (Pause.)

The film has conventions that are so familiar to us that we do not question them. Yet in dealing with people of a different background we have to start from nothing.

Q. Who was talking in the film.

A. The radio was talking. It was explaining in detail but of course I do not know.

Q. Everything that you saw was colourless. Is it possible that colourless things can be real?

A. The machine must make them. (Pause.) They are made without colour. I don't know. It comes to this edge (pointing) and then disappears.

Q. In the second film if you had touched the screen would your hand be wet?

A. No. A person can't put his hand there. It would burn it. It works by motor. I can't touch it.

Q. At the beginning the water was dirty. When the water was dirty could you smell it?

A. It cannot be smelled. This is water. It flows. Moreover this flows behind glass. This is a picture. It will not smell.

Q. In the first film there were cows. They were walking. If they walked more, would they have come near you?

A. No, they would not. (Pause.) Moreover, they were tied.

Laughable, to us, but we must learn that here even the picture is not understood unless perhaps it is a simple line drawing.



In fact the amount of understanding gained by the audiences at these tests was virtually nil. Even the memories left were vague and very inaccurate.

Perhaps we feel superior and want to laugh at such a failure to appreciate the product of our scientific efforts, but we also stand to be laughed at if we try to teach new ideas to the Greek hill farmer and the Dutch cattle raiser with the same method or with the same piece of celluloid.

#### The Selection of Films

After an initial experiment with some 60 films chosen almost at random from the American catalogues, the response from various quarters of Europe was sufficiently encouraging for the U.S. Government to agree to release money for a full-scale effort.

This involves screening several thousands films in America to select those apparently suitable. The European distribution rights of these films have then to be bought out and preprint material brought to Paris. Then the selected films are screened and if thought necessary, re-edited to give them a more suitable slant. It should be realized that many films made for prestige or even straight advertising purposes contain enough material

to turn into films which will teach something useful to someone inside our programme.

A glance at our criteria for judging films shows how broad are the principles we've evolved. So long as a film illustrates good practices and shows proven and up-to-date equipment; it is a film useful in training anyone from apprentices to managers; if the story in the film is such that it may stimulate the right kind of productive thinking, then it can be used. Any undesirable elements in the film can be omitted and in translating the script an entirely new slant can be given to the film.

To illustrate this let me quote one example. We were given three films, totalling more than an hour's footage, advertising an ingenious type of circular saw which works from above the bench instead of below, as in the more normal models. The saw is worked by a pistol grip and is mounted on a stand. The saw is free to rotate through 360 degrees either horizontally or vertically so that it can be set to practically any required angle in the sphere. Its variety of uses is enormous, especially when coupled with the almost unending types of blades, cutters,

**Table I.**  
**Production Activity Summary — M.S.A. Audio Visual Aids Section.**  
**16 mm. Films**

	FILMS	FOREIGN VERSIONS	PRINTS
January, 1951	75	34	449
July, 1951	130	289	2620
November, 1951	197	331	3921
March, 1952	243	390	5435

#### 35 mm. Filmstrips

	FILMSTRIPS	FOREIGN VERSIONS	PRINTS
January, 1951	23	58	798
July, 1951	83	94	1317
November, 1951	102	224	1777
March, 1952	209	423	2557

NOTE: Outstanding recent orders are at present in the region of 50,000 copies.

drills, etc., that can be interchanged at the cutting end.

The films were an enthusiastic expression of the producer's pride in the design and both commentary and picture were full of advertising sales talk.

With the active co-operation of the manufacturers of that saw, a fifteen-minute film has been made to show the principles of the idea, the scope of the work this saw can do, and the speed-up of production that can be achieved by such an instrument. Neither the name of the saw, nor the manufacturer's, is mentioned except in the credit titles.

#### European Distribution

Films leave Paris in batches of from ten to twenty, and are shipped to every country for local screenings. Experts and others decide on the spot which films could be used in any country and those chosen are then re-dubbed into the languages of the countries wanting them, and copies are made for pushing out into that country's non-theatrical distribution system.

That is the system for the United States product. The target of films from this source is 1,500 this year. This system also applies to filmstrips, wall charts, and any kind of visual or other material we can secure.

Then there are the films and other materials made in Europe. These, too, we are trying to utilise along with the United States product. The target here is everything suitable that we can get.

It is one thing to obtain films and release

translated copies. It is quite another thing to see that they are used effectively with the right audiences. It was stated earlier that when copies had been made in various languages they are put into the non-theatrical distribution channel of the country ordering them. In Britain, the C.O.I. had a comprehensive system for distributing and showing films of this sort. France, Denmark, Holland and others also have means of showing films to factories and farmers.

Yet in no country is the coverage complete and in many other countries little or no organized 16 mm. distribution exists.

If this programme is to succeed in any way the right films must get to the right people. A film on a cattle disease must get to veterinary students and to farmers raising that kind of cattle; a new discovery in the field of metallurgy must be brought to the attention of the relevant engineers, the men controlling certain factories, the scientists employed in that particular field of research.

This involves surveying distribution systems, widening and extending such systems, providing projectors or encouraging their purchase, advising on such matters as libraries, maintenance facilities and so forth. It means instructing teachers (in which are included management, agricultural advisors, firms, associations, trade unions and individuals), to use films and all that goes with them. It is surprising to know the extent to which opposition to the spread of knowledge can go. It is encouraging, on the other hand,

**Table II.**  
**Combined Totals of Films and Filmstrips at February 29, 1952.**

FILMS SCREENED IN U.S.A.	U.S.A. FILMS RECOMMENDED AS SUITABLE FOR CLOSE EXAMINATION	U.S.A. FILMS ACTUALLY RECEIVED IN PARIS	U.S.A. FILMS ACCEPTED FOR THE PROGRAMME
5000	1600	409 (124 not yet screened)	204

EUROPEAN FILMS FOR EXAMINATION LATER (ESTIMATE)	EUROPEAN FILMS RECOMMENDED AS SUITABLE FOR CLOSE EXAMINATION	EUROPEAN FILMS ACTUALLY RECEIVED IN PARIS	EUROPEAN FILMS ACCEPTED FOR THE PROGRAMME
2000	280	108 (30 not yet screened)	43

to discover the enthusiasm with which new ideas are being sought in Europe and the number of people who sincerely want this type of information.

To quote one example. A cloth manufacturer in Holland was having difficulty in solving a problem concerning the handling of large bales of material. It had been decided that only by complete reorganization could the difficulty be solved. In the middle of his troubles we sent a film to Holland illustrating an ingenious device, invented in America, to tackle this kind of problem. The ideas shown gave the Dutch manufacturer just the answer he had been searching for and saved him many thousands of pounds and a serious interruption in production.



are very hard to find; mostly, they have to be taken and trained. Their aim is to encourage and stimulate enthusiasm among people in each area so that the basic idea may grow. Financial assistance is given where this is needed and every possible effort will be made to increase local production by helping to set up a workable distribution and projection system.

At the moment the production effort is small—but a beginning has been made. Assistance is being given in Germany; a programme of considerable size is being started in Greece, covering nearly fifty agricultural subjects, for the improvement of crops and reduction of pests and disease. A similar programme is being formulated in Turkey



*Two frames from "Ideas at Work" made jointly by the M.S.A. and the C.O.I.*

If that film were of no use to anyone else in Europe it would nevertheless have justified itself in that one showing to one man.

In some fields there is quite a lot of material which can usefully be gathered together and co-ordinated into a training course, complete with books, lectures and even the lecturers themselves.

#### **M.S.A. Advisory Service**

With all this in mind, M.S.A. is going out to provide an advisory service of experts to give assistance on the problems of distribution and showing of films when and where such help is needed. Enough suitable people

and efforts are being made all round to make areas more self reliant in the technical fields of film production.

It takes time and patience. Technicians are needed in many countries, to work and to train others, but at the moment there is no livelihood in it.

One day, it is hoped, there will be one or more training aid centres in each country, devoted to the task of spreading knowledge of good practices in all industrial and agricultural fields and filling in gradually some of the innumerable gaps which must remain even after the fullest use has been made of all existing films.



## THE CHEMICAL CONTROL OF PROCESSING SOLUTIONS: A REVIEW OF CURRENT RECOMMENDATIONS

R. H. Bomback, B.Sc., A.R.P.S., A.R.I.C. (Member)\*

WITHIN recent years it has become the practice in most film processing laboratories to employ some form of chemical control of solutions to augment the purely practical or sensitometric tests normally undertaken by them. The reason is two-fold. Firstly, it allows a more precise and reliable operation to be exercised, and secondly, a considerable economy in chemicals can be readily achieved. To-day, both aspects are important and few laboratories find it profitable to forego the "luxury" of qualified chemical personnel on their staffs.

The basic principles underlying the application of chemical control techniques are substantially the same for all classes of photographic processing operations, and the particular type of technique to be adopted depends on local factors such as the nature of the materials to be processed, the composition of the solutions employed, the amount of material to be handled in a given time, and so on. Once these factors have been established, the details of the control to be introduced can be fairly easily determined.

### THE PROBLEM STATED

The processing of motion picture film is almost universally carried out on special machines in which the film is made to travel continuously, a break being made only when the work is exhausted or the end of the working period reached, whichever is the earlier. While the film is being fed through the machine, the processing solutions are pumped or circulated through the various tanks that go to make up the machine, although sometimes it is only the developer that is so treated. Circulation of the solutions to the machine is conveniently made via a spare tank, large enough to hold a considerable

bulk of solution in reserve. If the solution in this spare tank can be kept to within certain specified limits of chemical activity, it can be assumed, with reasonable safety, that the degree of development—or other chemical action—undergone by the film in the machine will be substantially uniform. The problem that besets the chemist is therefore to determine the limits to which he must work, and having done this, to instal and operate a technique to allow a periodical routine check to be made.

### GENERAL PRINCIPLES

Any technique of chemical control to be used as a commercial proposition must be simple to apply, although, of course, its supervision, and maybe also the interpretation of results can be left to the chemist in charge of operations. This has been the underlying principle in most systems so far proposed, and sufficient experience is now forthcoming to satisfy all enquiries on the score of their practicability. To those unfamiliar with chemical procedure, the techniques proposed may seem at first sight to be somewhat formidable, but when once broken down to easily understandable terms, they are seen in reality to be relatively simple devices for getting around extremely knotty problems.

We can perhaps best approach our subject by considering what happens when we first start to feed film into the developing tank of a processing machine. With every foot of 35 mm. film, sixteen separate pictures are developed, causing a certain amount of developing agent to be oxidised, and a certain amount of soluble bromide to be released into the solution. As the process is continued, and foot follows foot of film through the developer, a time is reached when an undesirable change can be detected in the

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\* Associated British-Pathé, Limited.

nature of the developed image. To counteract this change a so-called replenisher solution is fed into the developer, either direct, or more suitably, via the intermediate circulation tank; the constitution of the replenisher, and the rate at which it is added, are so adjusted that the overall rate of development of the film is kept constant at the required level. Thus, in general terms, this replenisher solution would contain relatively more developing agent, and relatively less soluble bromide, than the developer solution in use in the machine, while the amount added would depend on the footage of film processed.

In working out the actual formula for the replenisher solution to be used we are helped very considerably by the fact that in any given sequence on a film it is usual for the sixteen pictures in each foot of the film developed to vary but slightly from one picture to the next, so that any change in chemical activity exerted on the solution is likely to be steady and not subject to sudden, violent fluctuations. Naturally, there are fluctuations as the sequences change and within each sequence as well, but taken by and large, a carefully formulated replenisher solution can by itself do much to maintain a constant degree of development.

The precise nature of the replenisher to be used as well as its rate of addition, is a function of a number of local variables, such as the effectiveness of squeegees or other devices to remove excess solution from the film as it leaves the tank, the provision or otherwise of a positive "bleed," the nature of the developing agents employed, and so on. It should, however, be obvious that no one formula can be recommended as applying to other than a given, known set of conditions, and in practice it is the task of the chemist in charge of control to determine the particular formula that most adequately meets his need. This he can do in quite straightforward fashion by means of practical or sensitometric tests, and the need to carry out chemical analyses of the solution only arises when once he sets out to maintain a standard condition.

## ANALYSING THE DEVELOPER

### Metol and Hydroquinone

The majority of motion picture developers in everyday use are based on the metol-hydroquinone combination. It has been shown by Levenson<sup>1</sup> that in such developers it is the metol which is the primary reducing agent, the hydroquinone acting chiefly by reducing oxidised metol. In terms of routine chemical analysis of metol-hydroquinone developers, this means in practice that provided a close enough check be kept on the hydroquinone concentration, a satisfactorily constant degree of developer oxidation can be maintained. Furthermore, to hold the metol concentration steady at a pre-determined level, it is permissible to vary the hydroquinone concentration in the replenisher solution over a relatively wide range. Experiments made in the laboratories of Associated British-Pathé have shown, for example, that to cope with varying conditions of developer oxidation, the hydroquinone content of a positive film replenisher solution could be changed by as much as a ratio of 3 to 1 and still maintain the same level of metol concentration in the working developer solution.

Current practice in analysing metol-hydroquinone developer solutions is to employ the technique recommended by Levenson<sup>2</sup> and based on that described by Stott<sup>3</sup>. In this, a known quantity of developer solution is first acidified by adding 50 per cent. sulphuric acid (to reach pH=2.0) so that the metol base is converted to its salt. The hydroquinone is unaffected by this treatment and can be removed from aqueous solution by shaking with a suitable solvent. Ethyl acetate is recommended by both Stott and Levenson, but Baumbach<sup>4</sup> prefers methyl acetate, while Shaner and Sparks<sup>5</sup> claim superior virtues for methyl ethyl ketone. The shaking with ethyl acetate is repeated twice, after which the aqueous layer is set aside for metol determination.

To determine the hydroquinone content, a known fraction of the ethyl acetate used for the extraction is stirred into twenty times its bulk of water acidified with sulphuric acid.



It is then titrated with standard (usually N/100) ceric sulphate solution, using a calomel and a bright platinum electrode. The amount of hydroquinone can then be derived directly from the titre so obtained.

The metol is determined by first adding sufficient sodium hydroxide to liberate the free base from its salt (i.e.,  $\text{pH}=8.6$ ). A small quantity of sodium bicarbonate powder is then added to saturate the solution, so that the red colour of phenolphthalein indicator is discharged. Ethyl acetate is added and after shaking together, is removed from the

tioned by Levenson.<sup>1</sup> Provided due compensation is in fact made, an accuracy of about 1 per cent. for hydroquinone and 2 per cent. for metol may reasonably be expected.

Instead of using the somewhat complex potentiometric system of titration recommended by Stott, the end-point in determining metol and hydroquinone may be quite conveniently found by means of a suitable indicator. Ferroin (ortho-phenanthroline ferrous complex) has been suggested for this purpose by Brunner, Means and Zappert<sup>6</sup> and is found to work well in practice. The

Fig. 1.

*Continuous regeneration of processing solutions results in an economy not only of chemicals but of chemical mixing space as well. The relatively small capacity pictured here is quite adequate to meet the daily needs of the average-sized motion picture laboratory.*



(Courtesy of Associated British Pathé)

aqueous solution which is then discarded. After leaving to stand for some 20 to 30 minutes, a known fraction of the ethyl acetate solution is mixed into 20 times its bulk of water, acidified with sulphuric acid, and titrated as for hydroquinone. Again, the results can be expressed directly from the titre in terms of metol concentration.

The above technique is quite straightforward in practice, and if carefully performed will give satisfactory results. It must be pointed out, however, that it is subject to a number of errors and these can only be compensated by keeping strictly to a rigid set of operations. Particulars of some of these errors are given in the paper already men-

same authors point out that of the solvents recommended for extracting the metol and hydroquinone, ethyl acetate and isopropyl acetate are the most suitable when titration is to be carried out with ceric sulphate. With methyl acetate a slight darkening occurs during titration which may be objectionable, while methyl ethyl ketone cannot be used because it is itself oxidised by ceric sulphate. Another suggestion made by these authors is to titrate the metol extract potentiometrically against standard hydrochloric acid in place of ceric sulphate, but no true inflection point is obtained in this way. Idelson<sup>7</sup> claims that, for metol determination, better results are given by using glacial acetic acid in place



of water as the solvent for the titration and decinormal sulphuric acid, or perchloric acid in acetic acid, as the titrant in place of hydrochloric acid. Crowell, Gausman and Baumbach<sup>8</sup> confirm these latter findings and point out that titration can be carried out satisfactorily, using crystal violet or orange IV indicator solution in place of the potentiometric technique.

In an endeavour to avoid the need to separate the two components in a metol-hydroquinone developer, the proposal has been made by Rees and Anderson<sup>9</sup> to measure physically the absorption of the developer at two wavelengths in the ultraviolet (270 and 290 mμ). From the readings so obtained the concentrations of both metol and hydroquinone can be determined directly. The method is restricted to fresh, unused developer and if a partially used solution is to be analysed, the unoxidised developing agents must first be extracted with ethyl acetate. All measurements are made on developer solution diluted with one hundred times its volume of pH=5 acetate buffer.

Similar attempts have been made to produce measurable colourations by means of addition agents which react specifically with either metol or hydroquinone. Some early recommendations in this direction by Evans and Hanson<sup>10</sup> were based on the reaction between metol and fural acrolein, while for hydroquinone an addition of potassium ferricyanide and sodium sulphite was made. In both cases the colours are to be measured on a filter photometer, but it is, in this case, necessary to make the usual separation of the two developing agents before the test can be applied.

#### **P-Aminophenol**

Like metol, this developing agent is used in its salt form (e.g., ovalate), and the free base can only be extracted from aqueous solution when the latter is made sufficiently alkaline. Atkinson and Shaner<sup>11</sup> have described a method of quantitative estimation of this agent which depends on extraction by

ether followed by titration against standard iodine solution using starch as indicator.

#### **Amidol, Glycine**

These may be estimated in the way described as for p-aminophenol.

#### **Pyro**

According to Atkinson and Shaner,<sup>11</sup> pyro may be extracted directly from an acidified developer solution, using ether as the solvent and weighing the extract. If hydroquinone be also present, the pyro may be separated by precipitating the lead salt of pyro with lead acetate solution. This is weighed and the amount of pyro determined directly by taking it as equal to one-third of the quantity of lead salt produced.

#### **P-Phenylenediamine**

The same authors recommend that this developing agent be determined by extraction with ether and titration against iodine. It may also be determined by extraction as for metol or hydroquinone, using ethyl acetate and titrating against ceric sulphate, using ferroin as indicator. This procedure is the one recommended by Brunner, Means and Zappert<sup>6</sup> for the estimation of diethyl p-phenylenediamine chloride in Ansco Colour Developer A-605.

#### **Halides: Bromide and Chloride**

The basic technique for the estimation of halides in developer solution is that described by Stott.<sup>3</sup> In this, a known quantity of developer is boiled to complete the reduction of any silver that may be held in solution by sulphite, and then sufficient sulphuric acid (50 per cent. solution) is added to decompose all the sulphite present. The solution is boiled again to drive off the liberated sulphur dioxide and, after cooling, sodium acetate solution is added to serve as a buffer. Titration is carried out against standard silver nitrate solution, using calomel and silver electrodes. The resulting curve will show inflection points for both bromide and chloride ions present in the developer.

According to Crowell, Luke and Baum-

bach,<sup>12</sup> the inflection points found in this way do not coincide with the equivalence points, and improved results are said to be gained by the addition of substances such as barium nitrate, alum and the like. These authors point out that where both bromide and chloride ions are present together, the error in titration for a given concentration of bromide ions depends on the ratio of chloride ions to bromide ions in the solution. Suitable calibration curves can be worked out to give the required degree of compensation, but for routine analyses, where reproducible results can be obtained by titrating to the same end-

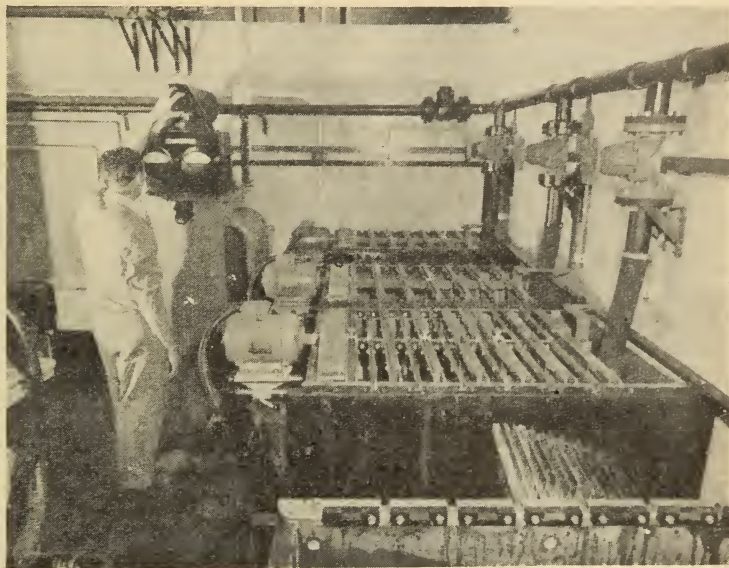
the developer as well as bromide, e.g., Ansco Colour Developer A-502, the results are misleading unless the two can be separated. The technique recommended<sup>6</sup> depends upon prior oxidation by means of hydrogen peroxide followed by the standard Volhard bromide procedure.

### Iodide

An analytical procedure described by Evans, Hanson and Glasoe<sup>13</sup> involves precipitation of the dissolved halides with silver nitrate solution followed by oxidation of the iodide while still in the form of solid silver

Fig. 2.

*Where the used hypo is desilvered electronically, as shown here, regular determination of silver concentration, solution pH, etc., must be made to prevent undesirable complications such as sulphurisation, imperfect plating, and so on.*



(Courtesy of Associated British-Pathé)

point each time, the use of such curves becomes unnecessary. Also, according to these authors, there is no need to boil the solution or to add sodium acetate as recommended by Stott.

Brunner, Means and Zappert<sup>6</sup> agree with Crowell, Luke and Baumbach that the solution need not be boiled either before or after acidification. They further postulate that no advantage is gained by the addition of substances such as barium nitrate or alum as recommended by the previous authors.

Where potassium thiocyanate is present in

iodide to iodate by chlorine water. The iodate is then determined polarographically to give results accurate to within 2 to 4 per cent. Thiocyanate ions, if present, interfere and must first be removed by boiling with strong sulphuric acid before precipitation is performed. Excess chlorine should be removed by addition of phenol. Since the potential at which the curve for iodate occurs is a fairly steep function of pH in acid solutions, but independent of pH in alkaline solutions, the iodate solution is rendered alkaline before electrolysis is carried out.

### Sulphite

Estimation of sulphite (and bisulphite) can be carried out quite simply by using Stott's recommended technique.<sup>3</sup> A known quantity of deci-normal iodine solution is placed in a flask and acidified with concentrated hydrochloric acid. Titration is carried out with developer solution added from a burette until the brown colour is discharged. There is no need to carry out the titration potentiometrically, nor even to add starch as indicator.

### Carbonate

A method which is independent of the presence of calcium carbonate scale, etc., is that described by Stott.<sup>3</sup> In this, a known quantity of developer solution is added to twenty times its volume of distilled water. Titration is carried out with deci-normal hydrochloric acid, using calomel and platinum, or glass, electrodes. The results are based on the first break in the curve so obtained, corresponding to the conversion of sodium carbonate to sodium bicarbonate.

Brunner, Means and Zappert<sup>6</sup> have criticised this method on the grounds that the inflection point is made unsharp because of the buffering action of the sulphite present. They propose, instead, that the developer be titrated directly with standard acid to about pH=4, at which point the carbonate has been completely neutralized and the sulphite converted to bisulphite. The carbonate content may be calculated by deducting the volume of acid required for the sulphite present. An accuracy of  $99 \pm 1$  per cent. is claimed. It may be mentioned, in passing, that Atkinson and Shaner<sup>10</sup> had previously considered this technique to be insufficiently accurate for control purposes.

### pH MEASUREMENT

Generally speaking, the activity of a developing agent is independent of the kind of alkali present in the solution, and is a function solely of pH. The measurement of developer pH values is, therefore, of importance in any routine control procedure and is commonly carried out as a regular thing.

Too much importance should not be placed on the pH value alone, however, since the photographic properties of a developer solution can vary while the pH remains constant. Thus, an exhausted bath does not necessarily show a lower value of pH and it does not even follow that a higher pH will always show a more energetic developer. Atkinson and Shaner<sup>11</sup> point out that the successful application of pH measurement to developer control requires a knowledge of the concentration of all the important constituents of the developer as well. The measurement of pH is thus to be regarded as a useful factor in the control of developer solutions, and where carried out continuously serves to give warning of any sudden and unexpected change in bath characteristics, such as may occur, for example, through admixture of wrongly compounded replenisher, and the like.

While measurements of developer pH may be carried out colorimetrically, more accurate and reliable results are obtained with a glass electrode/calomel assembly; a silver chloride electrode can be used in place of calomel with equal facility. Even with this arrangement really accurate results are unlikely to be obtained at pH values in excess of 9.5 because of the considerable salt errors introduced via the glass electrode. Some mitigation of these errors can be achieved by the use of a special glass electrode, such as the "Alki," as well as by the standardisation of the electrode in buffer solutions that are similar in their salt concentration to that of the developer under test.

Because of the difficulty of specifying exact conditions of measurement values of pH quoted for developer solutions are rarely comparable with any degree of exactitude from one laboratory establishment to another. Where reproducible—rather than absolute—accuracy is all that is required, however, interpretation of results is very much simpler, and for this reason the quotation of pH values forms a valuable guide to the conditions obtaining within any one establishment. Work is in progress to improve this



condition and a committee of the British Standards Institution has the matter under active consideration.

### THE FIXING SOLUTION

Control of the fixing solution need rarely be carried out to the same degree as the developer solution, and where routine chemical analyses are performed these are usually restricted to determination of hypo, silver and solution pH. Occasionally, determinations of sulphite and of hardening constituents are required to be made as well. The techniques commonly employed are as follows:—

tration is required, a simple physical check of specific gravity will provide the answer more readily. The following table gives typical results for a plain hypo fixer:

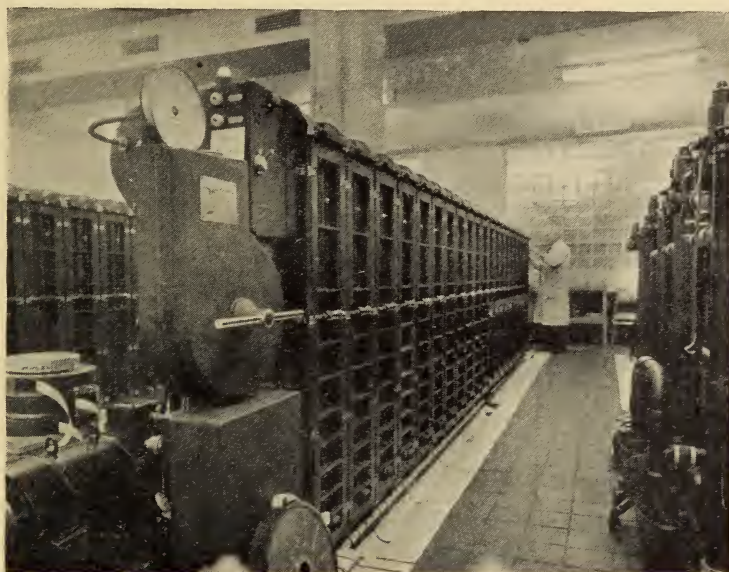
Hypo Strength	Specific Gravity
50% W/V	1.230
40%	1.190
30%	1.143
20%	1.095

### Silver

The same authors recommend that silver be determined by precipitating as sulphide, dissolving the latter in nitric acid and titrating against thiocyanate with ferric alum

Fig. 3.

*With continuous processing machines designed to be operated in daylight (e.g. Debrie "Multiplex" machines pictured here), visual inspection of the developing machine is impossible. The need for chemical control of the developer, etc., is therefore of special importance with this type of equipment.*



(Courtesy of Associated British-Pathé)

### Hypo

Atkinson and Shaner<sup>11</sup> recommend simple titration of the fixer solution into deci-normal iodine solution. Naturally, if sulphite ions are present as well they will interfere with the result, and to avoid this complication excess formaldehyde should be added and titration carried out in acetic acid solution. It follows that if the titration be performed with and without formaldehyde, the difference between the two results will give a measure of the sulphite content of the fixer.

Where only a rough guide to hypo concen-

indicator. If chromium ions be present as well, ammonia should first be added in slight excess and the solution boiled for several minutes. After filtration through paper on a Buchner funnel, the filtrate is treated with sodium sulphide solution until no further precipitation occurs. This is then filtered over the same filter paper as before and the precipitate washed. Both paper and precipitate are then placed in a beaker and digested with nitric acid. The resulting solution is filtered to remove sulphur and paper pulp, after which it is titrated against thiocyanate

solution, using ferric alum as indicator.

For routine control purposes, sufficiently reliable estimations of silver in hypo can conveniently be made colorimetrically, either visually, or more accurately, by photo-electric means. The procedure normally used is that originally described by Weyerts and Hickman<sup>14</sup> and depends upon the production of a reasonably stable silver sulphide sol. The depth of colour of a given concentration of silver sulphide depends on the covering power of the colloidal sulphide particles, and this in turn depends on the pH, the neutral salt content, and the "protective" powers of the solution conferred on it by dissolved gelatin. In preparing the sulphide sol for measurement, citric acid and sodium citrate are first added to a known volume of fixer solution to keep the pH in the desired range, together with sufficient gelatin to ensure sufficient protection to the colloidal particles. A solution of sodium sulphide, to which sodium sulphite has been added to prevent the unwanted generation of colloidal sulphur, is then run into the treated fixer solution until production of the silver sulphide sol is complete. The colour produced is then either compared visually with standard solutions or measured directly on a suitably calibrated colorimeter. In dealing with fixer solutions rich in silver, it may, of course, be necessary to dilute with water first in order to produce a solution that comes within the measurable range.

#### Aluminium, Chromium, etc.

Where an estimation of aluminium or chromium (alums) is required recourse may be had to the technique described by Atkinson and Shaner.<sup>11</sup> An alternative procedure, which depends on the use of the polarograph, is described by Shaner and Sparks.<sup>15</sup>

#### OPERATION OF CONTROL

The practical application of the various

techniques described above is a matter which must depend to a great extent on factors which vary from one establishment to the other. Thus, the type of test to be applied, and the frequency of testing, are matters to be decided in the light of the sort of work undertaken, its bulk, the rate at which it is processed, and so on. Testing may be continuous or irregular, and no hard and fast rule can be laid down without a knowledge of all the factors involved.

As a guide to what is required in a modern laboratory handling only black-and-white material, the following information is based on average conditions operated in the Wardour Street laboratories of Associated British-Pathé.

#### Positive Developer—D.16. Type

Volume of solution in circulation...1750 galls.  
pH measurement

Continuous (automatic recording)  
Hydroquinone analysis.....Daily  
Metol analysis.....Alternate days  
Bromide analysis.....Irregular  
Sulphite analysis.....Weekly

#### Fixer Solution—Acid Hypo

Volume of solution in circulation...800 galls.  
Hypo analysis.....Daily  
Silver analysis.....Daily

Using the above type of chemical control, and supplementing it with further tests only where special demands seem to make it necessary, no particular difficulty is experienced in maintaining reasonably uniform chemical activity of the solutions concerned. As one direct result of this, the positive developer is never discarded and is merely filtered, sterilised, and replenished regularly in the light of the chemical analyses carried out on it. In this way, an economy in chemicals consumption is achieved as well as the provision of stabilised processing conditions.

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## BOOK REVIEWS

*Books reviewed may be seen in the Society's Library*

**COLOUR CINEMATOGRAPHY.** Major Adrian Cornwell-Clyne, M.B.E., F.R.P.S. (Member). Chapman & Hall Ltd., pp. 780, 84s.

The technician and the student are particularly badly served by the literature in the field of colour motion pictures, for almost the whole of it is contained in the pages of technical journals. Again, since the relevant material is quite widely scattered both in time and country of origin, anyone who needs information on any aspect of colour cinematography faces an almost impossible task. For this reason, if for no other, a new and up-to-date edition of Major Cornwell-Clyne's book is to be welcomed; the historical summary with which it opens contains information about almost every colour process, suggested, attempted or actually used since the beginnings of the film industry.

The second chapter, headed "The Theoretical Basis," occupies almost exactly one-third of the book and whilst it contains enormous quantities of the most useful data it is organised badly and lacks form. At times, too, this chapter digresses into matters which are more a question of practice than theory; details of the photography of cartoon material by the successive frame method, or the conversion of black and white cameras to run bipack, to quote but two examples.

The two following chapters are devoted to a detailed account of additive and subtractive processes. Of some sixty-two pages taken up by the additive processes, thirty are devoted to Dufaycolor. The chapter on subtractive processes achieves a rather better balance and is notable for what must be the most complete account of the Technicolor process to appear in print. This description is, however, somewhat obscure at times, since laboratory vernacular, which is peculiar to the process and therefore not generally understandable, is frequently used. Indeed, in some cases it would appear that the author himself is not clear as to what is meant.

Chapter Five is concerned with "Colour Camears (*sic*) and Beam Splitting Systems" and, as in former editions of this book, consists of an extremely thorough and systematic examination of all the possible methods of recording a number of colour separation images. Since this aspect of colour cinematography has been a fruitful field for the crank inventor, or, as has so often been the case, re-inventor, such an evaluation of the factors involved and the practicality of various systems is invaluable.

Part One of the volume is concluded with a chapter devoted to the practical aspects of bipack.

Part Two consists of seven chapters which are



very much shorter than those in Part One and deal with such variously assorted topics as process projection, sound tracks, toning methods, stereoscopy in colour, make-up and colour sensimetry.

This section is followed by Part Three, which discusses colour vision, colour harmony and colour standards. The final ninety-five pages comprise fourteen appendices dealing with those processes of too-recent origin to be included in the main body of the book, information on the handling of Ansco Reversal Color Film and patent surveys.

Thus it will be seen that "Colour Cinematography" covers a great deal of ground and presents an enormous amount of information. However, it is felt that the presentation is capable of some improvement; rigorous editing would remove the digressions, irrelevancies and repetitions, allow publication in a more convenient format, and, it is hoped, at a lower price.

In view of some of the author's statements in the chapter on colour harmony the dust jacket is somewhat startling.

GEORGE W. ASHTON.

**COMPOSING FOR THE FILMS.** Hans Eisler.  
Dennis Dobson, Ltd., pp. 165, 12s. 6d.

When I reviewed this book for the "Spectator" I was writing for a cultured section of the general public and had to explain things which were mysteries to them. But it will not be necessary to explain to my professional brethren that films must be made to sell, and that if the general public is not attracted the distributors can never recover the cost of the film so that it can be ploughed back into the industry to start making others.

The function of the musician, like that of the other artists and craftsmen employed, is to use his art to reach the general public, largely unmusical, which forms the large bulk of the distributor's customers. He must therefore either use simple forms and clichés which the unmusical can understand, or else attempt to affect them subconsciously, in which case he can be as high-brow or atonal as he wishes, provided he does not annoy the customer to the extent that he throws a brick at the loudspeaker.

Mr. Hanns Eisler is himself a first-class practitioner, and was hailed as an Evangel of modernity in Dr. Kurt London's book on Film Music which was projected into our metropolis about 16 years ago. Few of the revolutionary changes in recording prophesied in that book have come to pass in this country at any rate, but Mr. Eisler was appointed by the Rockefeller Foundation to investigate the making and using of film music, and his conclusions are entitled to respectful consideration. He writes about what

is loosely called "background music," and I think we shall all agree that an educated composer will do a better job than a hack, even on matter-of-fact descriptive music. We can sympathise with Mr. Eisler in some of his troubles with unsympathetic and unmusical directors, which, though the common lot of all working in film music, has many pleasant exceptions. But he does not, I think accept the axiom that film music must be ancillary and subordinate, and cannot claim any intrinsic rights in the name of music against the film itself.

Some films, of course, demand bad music—and get it, and some use very little music outside the Titles. There are also some cinema patrons who dislike incidental music of any kind, and many who absorb it unconsciously without hearing it. But I think music can do great service in illustrating silent sequences, intensifying exciting ones and supporting weak ones; it must be applied *ad hoc*, and the first thought must always be to serve the picture and help the distributor in his difficult job.

Mr. Eisler states on page 55 that "no serious composer writes for the motion pictures for any other than money reasons." Very well then, the remuneration is very good and the composer should be willing to clip the wings of his musical inspiration a little, to hand over a useful and helpful score.

There is plenty of interesting reading for the handful of people who really understand the subject, but as a guidebook for the ambitious student the work is likely, I fear, to mislead.

ERNEST IRVING.

**THE FILM IN EDUCATION.** Andrew Buchanan,  
D.Litt., Ph.D., F.R.S.A., with an introduction by  
Dr. J. A. Harrison. Phoenix House, pp. 256. 25s.

Dr. Buchanan is a practised writer with a gift for making readable material from an array of facts gathered from official reports, interviews and literature on the film. But despite the craftsmanship that has gone into this new book, the reader may set it down with a sense of disappointment.

To-day, three obstacles prevent the fullest use of the film in education. To one—the difficulty of covering production costs while many schools lack projectors and too many education authorities make only grudging allocations for film hire and purchase—the author devotes adequate attention. But it is equally important to know how to produce the right films and how to ensure, when they reach the classroom, that they are used in the most efficient way. More information is needed by producers about the effect of each visual and aural device upon the mind of the child for whom it is intended, and there is still little agreement among teachers upon the way film

should be fitted into the framework of the lesson.

To both these problems—whose solution can come only from research—Dr. Buchanan pays scanty attention. Yet once the answers are found the economic problem will also be near solution. When the majority of teachers are convinced that a film can convey more to their pupils than the older aids to education there will be no lack of demand for projectors and prints.

Apart from these omissions, the book has solid merits. As a survey of the present status of the education film here and abroad it is excellent; particularly useful is the clear summary of the functions of the National Committee for Visual Aids in Education and the Educational Foundation for Visual Aids—two unique official bodies which, while financed by public funds, insulate the classroom from Government intervention.

"Perfect projection is essential . . . the whole quality of a film can be lost when it is inexpertly shown," says the author. This cannot be repeated too often, both in and out of the classroom. He gives some useful hints on presentation, although the statement (p. 189) that exciter lamps can be easily adjusted is optimistic and the warning (p. 192) that sound films cannot be shown on silent projectors is needlessly discouraging; on several modern projectors they can and are.

BRIAN WATKINSON.

**ENCORE.** *Stories by W. Somerset Maugham. Screen adaptation by T. E. B. Clark, Arthur Macrae and Eric Ambler. William Heinemann, Ltd., pp. 165, 9s. 6d.*

Following the lines of "Quartet" and "Trio," its predecessors, "Encore" gives us three more of W. Somerset Maugham's original stories which make up the film, and also their respective shooting scripts by T. E. B. Clarke, Arthur Macrae and Eric Ambler.

To the film maker or to the student of film making the interest in this book comes not so much from the stories or from the scripts, but from the comparison of each story with its own

particular script. The stories and scripts can hardly be reviewed in the ordinary way for obvious reasons, but the book is a valuable addition to the library as an example of the art of transforming the written words of fiction into living shadows having so much more impact on the senses than perhaps the first author had ever conceived.

In their original form, the stories are sketches of people, places and events, written sometimes in narrative form and embellished with dialogue here and there to illuminate the personalities of the characters; but the scripts demonstrate in the most vivid manner the remarkable ability of the adaptors to invest these stories with all the characterisation, wit and humour necessary to make them eligible for screen entertainment.

The universal success of "Encore" with the public is proof enough of the merit of the work of these writers. The book is a tribute to their achievement and an example to those who would aspire to ring the same bell.

For many of us within the industry it would be a most salutary lesson if we could at some future date read of the turmoil and grief, the doubts and fears, the rejects, re-writes and re-types that had to be endured before perfection was attained. How about it T. E. B., A. M. and E. A.?

WILLIAM HAMMOND.

**WORLD COMMUNICATIONS: PRESS, RADIO, FILM AND TELEVISION.** *U.N.E.S.C.O. Publication. H.M.S.O. 13s. 6d.*

Tabulated data of the world's press, film, radio and television facilities, is set out in this valuable U.N.E.S.C.O. publication.

There is a section which includes statistics of the production, distribution and exhibition of films, as well as import and export figures of equipment and raw film stock.

The rapid advance of television is apparent by news of the latest facilities in eighteen countries.

A. R. R.

## PROPOSED AMERICAN STANDARD

Efforts to reduce costs in colour cinematography have led, in the past few years, to an appreciably increased commercial use of 16 mm. film as original negative for 35 mm. release prints. Optical enlargement is, of course, an essential factor in this process. A standard magnification ratio thus becomes a necessity since the difference in aspect ratios

of the two film sizes precludes the simple use of the 35/16 ratio.

A proposed standard enlargement ratio for 16 mm. to 35 mm. optical printing has been approved for publication by the Standards Committee of the A.S.A., and it is reprinted here from the Journal of the S.M.P.T.E., Vol. 58, No. 1.



The Committee of the British Standards Institution, working on this problem, would welcome any comments on this proposed American standard. These should be sent to the Society for forwarding.

#### Enlargement Ratio for 16mm. to 35mm. Optical Printing

In the enlargement printing of 16 mm. film to 35 mm. film, a magnification of  $2.21 \pm 0.01$  shall be employed and the centre of the 16 mm. frame as enlarged shall coincide with the centre of the 35 mm. aperture in the enlarging printer.

This will mean a scanned area on the 16 mm. frame of  $0.272 \text{ inch} \pm 0.002 \times 0.373 \text{ inch} \pm 0.002$  will be projected through the 35 mm. projector aperture when the print is used in the theatre. This corresponds to a frame of  $0.284 \text{ inch} \times 0.380 \text{ inch}$  if the 16 mm. original were projected directly.

The scanned area of the 16 mm. frame in the printer as enlarged to the 35 mm. camera aperture is  $0.286 \text{ inch} \pm 0.002 \times 0.393 \text{ inch} \pm 0.002$ .

Attention of camera users is invited to the desirability of using a camera finder matte  $0.272 \text{ inch} \pm 0.002 \times 0.373 \text{ inch} \pm 0.002$  when exposing 16 mm. film to be enlarged to 35 mm. film.

**Note :** In enlargement from 16 mm. positive or reversal original to 35 mm. negative a black frame line will result on the final 35 mm. print. In the case of enlargement from 16 mm. negative directly to 35 mm. print, white frame lines will result. If the height of the 16 mm. aperture for enlargement from 16 mm. negative to 35 mm. print is made 0.300 inch, the resulting aperture image on the 35 mm. print will be from 0.660 to 0.666 inch in height. While the frame line will not be entirely black, there would be a black margin on either side of the image which would give an additional safety factor in projection.

## THE COUNCIL

*Summary of the meeting held on Wednesday, March 5, 1952, at 117, Piccadilly, London, W. 1.*

**Present :** Mr. L. Knopp (*President*) in the Chair, and Messrs. B. Honri (*Vice-President*), Mr. H. S. Hind (*Deputy Vice-President*), A. W. Watkins (*Past President*), R. J. T. Brown (*Hon. Secretary*), N. Leever (*Hon. Treasurer*), D. F. Cantlay, F. S. Hawkins, T. W. Howard, R. E. Pulman and S. A. Stevens.

**In Attendance :** Miss J. Poynton (*Secretary*).

An apology for absence was received from Mr. F. G. Gunn.

**Society Dinner.**—Owing to the death of H.M. the King it was decided not to hold the Society Dinner which had been arranged for April 8.

**The Convention.**—The Annual Convention will take place on Saturday, May 3, 1952, at Film House, Wardour Street, W.1.

William Francis Elliott (Member), G.B. Equipments, Ltd., Mortimer House, Mortimer Street, W.1.

Albert Rivers (Associate), Guild Holdings, Ltd., Guild House, Upper St. Martin's Lane, W.C.2.

John Percy Hartley Walton (Member), British Film Producers' Association, 49 Mount Street, W.1.

Frederick Downton (Associate), B.B.C. Television Service, Lime Grove, W.12.

The resignations of five Members and four Associates are noted with regret.—*Report received and adopted.*

**Tele-Kine Group Co-ordinating Committee.**—The success in London of the course on "Television in the Kinema" has occasioned requests for a similar course in nine provincial centres. Steps are being taken, if possible, to arrange for the courses to commence in the autumn. It is intended to publish the lectures, at least for those who have attended the course.—*Report received and adopted.*

**Projectionists' Training Scheme.**—The work of approving a draft syllabus for the training of projectionists is nearing completion. A number of technical colleges are desirous of including the syllabus in their autumn curriculum.—*Report received and adopted.*

## COMMITTEE REPORTS

**Membership Committee.**—The following are elected:

Horace Booth (Associate), Western Talkie Theatre, Armley, Leeds, 12.

Jan Izyski-Herman (Associate), Radiant Films, Ltd., Bradford Road, Slough, Bucks.

William Tait Anderson (Student), North Star Cinema, Lerwick, Shetland.

James Gerald Warnasuriya (Member), Studio Manager, Pakistan Studios, Ltd., Karachi.



**Foreign Relations Committee.**—The Council's approval has been given to the recommendation that the Committee in future shall be renamed "The International Relations Committee." The appointment of Society representatives abroad is progressing.—*Report received and adopted.*

**Publications Committee.**—It is hoped that the stouter cover being used on future publications of *British Kinematography* will meet with members' approval.—*Report received and adopted.*

**16 mm. Film Division.**—The following *Ad Hoc* Committee has been investigating the opportunity which exists for keeping abreast of new technicalities in 16 mm. production: Messrs. C. B. Watkinson (*Chairman*), G. H. Sewell and P. W. Dennis. It is likely that the programme for next Session will include viewings of films of unusual technical interest.—*Report received and adopted.*

The proceedings then terminated.

#### PERSONAL NEWS OF MEMBERS

Members are urged to keep their fellow members informed of their activities through the medium of *British Kinematography*.

JACK H. R. COOTE has joined Ilford, Ltd.

GROUP CAPTAIN G. THRIPP has been elected a Full Member of the Brit. I.R.E.

Small announcements will be accepted from Members and Associates. Rate, 4d. per word, plus 2s. for Box No. if required (except for Situations Wanted). Trade advertisements, other than Situations Vacant, not accepted.

#### EXPOSURE FOR COLOUR

An illustration of the energy distribution of fluorescent and tungsten lamps of the same colour temperature was inadvertently substituted for one showing the spectral distribution of incandescent light compared with that of arc or daylight, in the paper "Exposure for Colour," printed in the last issue.

#### TECHNICAL ASPECTS OF "THE TALES OF HOFFMAN"

Attention has been drawn to the publication of "Technical Aspects of 'The Tales of Hoffman,'" by Christopher Challis, in the February issue. Reference was made to the lighting of the studio set in Act I, which included a statement to the effect that "the studio roof began to sag."

This is an unfortunate error, and the correction is gladly published that at no time did the roof sag. The reason why further lamps could not be hung was that the maximum weight, as allowed by the building specification, was already suspended from the overhead runways on this set. In the interest of safety no excess of these limits was permitted.

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# BRITISH KINEMATOGRAPHY

Wright-Patterson  
Technical Library  
Dayton, Ohio

VOLUME 20, No. 5

MAY, 1952

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## THE NEW TELEVISION DIVISION

FOR some years the Council has been aware that a comparatively large proportion of members is taking an increasing interest in television in studios and theatres, and they have expressed their desire that the Society pays greater attention to this important development. At last year's Annual General Meeting several members spoke on this subject, and a promise was given by the President that the matter would be given the fullest consideration. During its deliberations, the Council was led to understand that in addition to the desire within the Society for the formation of a television division, there was a comparatively large number of technologists engaged in the use of motion picture films for television purposes, who are in need of a suitable venue for discussions and for the interchange of information.

To meet the desires of members and to provide a suitable avenue for a closer co-operation between those engaged in cinematography and television, the Council has decided to inaugurate a Television Division within the framework of the Society.

The new division will be controlled and organised by its own committee and its constitution will be similar to that of divisions already in existence. Divisional discussion meetings will be held during the forthcoming session, and arrangements are well ahead to give to projectionists in provincial areas the lectures

on the principles of large-screen television which were so successful in London at the beginning of the year.

All members, associates and students interested in television are eligible for membership of the Division and application for enrolment can be made on the special forms obtainable from the Secretary.

The Council hopes that the formation of this Division will be an incentive to the television technicians who have been frequent visitors to our meetings and lectures, to join the Society.

The use of the motion picture film in television forms an important and growing proportion of broadcasting programmes and consequently there is an increasingly expanding area of common interest—studio lighting, camera work, photography, sound recording, film processing and projection engineering—each presents common problems which can best be solved by a mutual pooling of knowledge and experience.

The use of television cameras and reproducers in studios is providing valuable experience to technicians already employed in the film industry, and although we have not yet reached the stage where television projectors are in normal use in cinemas, the experimental screenings given since the war, particularly recently at the Festival of Britain Telekinema, indicate that public opinion and demand will eventually prise open the doors which political pressure has kept closed.

LESLIE KNOPP.

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## TECHNICAL CONTROL IN THE FILM PROCESSING LABORATORY

R. H. Bomback, B.Sc., A.R.P.S., A.R.I.C. (Member)\*

As a service department within the motion picture film industry the processing laboratory is inevitably placed in a distinctly delicate position. It is at once weak and strong—weak, because its work is non-creative and as such contributes little to the formative processes of film production; strong, because it forms a vital link in the chain of events that lead to the showing of a picture on the kinema screen and as such cannot (as yet) be dispensed with, however unpopular its efforts may at times appear. Frequently the laboratory is inarticulate, its protests are feeble or scarcely heeded, and on those occasions when its work may be said to amount to no more than that of “making the corpse look nice,” it is in the nature of things that it should be blamed for the result.

People whose business it is to make use of the film processing laboratories are sometimes apt to view these establishments with misgiving. Maybe they have the best of reasons for so doing and possibly nothing will shake the views they hold about them. But many do so because they simply do not understand the type of work that goes on inside the laboratory itself. To them it is a sort of sausage machine, greedily engulfing the precious manna fed in at one end and haphazardly pushing forth the so-called end-product at the other. It is in the hope of enlightening the latter that this article is presented, the opportunity for so doing being provided by the recent opening of a modern laboratory† in London, a project with which the author has been intimately connected.

### Function of the laboratory.

The well-equipped laboratory is designed to undertake some or all of the following types of operation.

1. Development of negatives, picture and sound, and editing of same.
2. Production of intermediate dupe positives and negatives.
3. Production of rush prints, with as little cally perfect as possible.
4. Production of show prints, as technically perfect as possible.
5. Production of release prints, of a consistently high level of quality, usually with little or no time to be lost in meeting distribution requirements.
6. Optical and special effects work, titles, etc.
7. Reduction prints and “blow-ups.”
8. Re-recording of sound tracks, special track tests and the like.

When it is remembered that added complications intrude such as colour and the need to carry out each part of the work at an economically satisfactory level it will be appreciated that the successful operation of a processing laboratory calls for the exercise not only of careful organisation and planning but of reliable technical control as well.

### Technical Control.

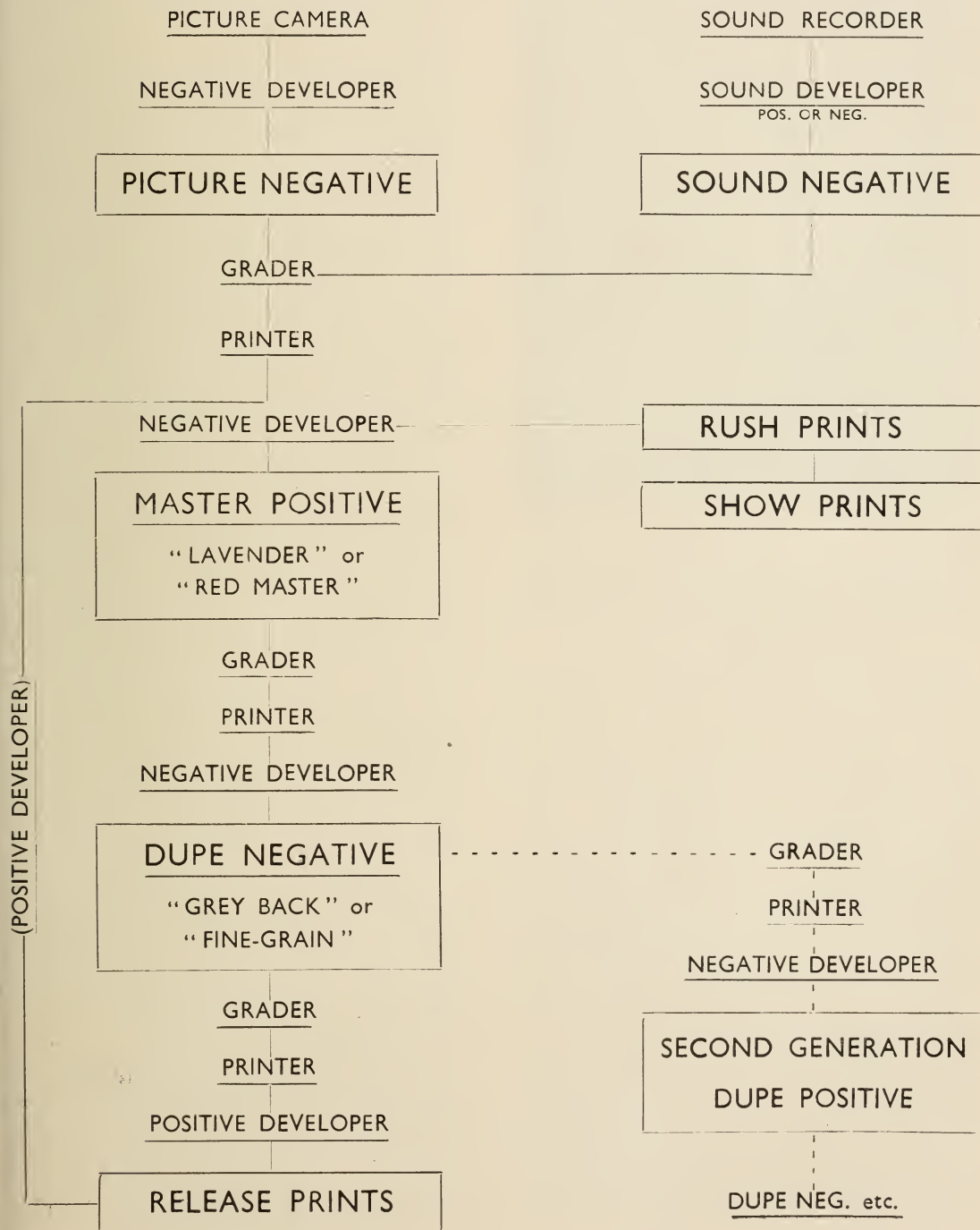
It is perhaps this nebulous quantity, this business of technical control, that is the least understood item in the stock in trade of the laboratory. To some it is but a cipher, no more than another alibi to explain away a disappointing result; to the more discerning however, it is seen as an honest and intelligent endeavour to provide the right sort of result, not only once but on each and every occasion. The form it takes varies and the interpretation placed upon it by one laboratory may be different from that of the next, but generally speaking the principles adopted are now fairly well

Manuscript received April 1, 1952

\* Associated British-Pathé Limited.

† Associated British-Pathé Laboratories, Wardour Street and Elstree.

FLOW-SHEET OF WORK IN PROCESSING LABORATORY  
SHOWING STAGES AT WHICH TECHNICAL CONTROL IS NECESSARY.





(Courtesy of Associated British-Pathe)

*Visual grading of a negative pre-supposes the existence in the laboratory of standardised printing and processing operations. Any sudden change in these—either deliberate or accidental—cannot easily be compensated by the grader.*

known and standardised throughout the industry.

The importance that the laboratory rightly places on technical control of all its operations can be best appreciated by a glance at the "flow-sheet" of its work. At each of the points listed control must be exercised if some loss of quality in the final product is not to be incurred.

Before the advent of sound considerable latitude was no doubt permissible in the handling of motion picture film since the judging of the screened image was to some extent a matter of artistic consideration. The introduction, in 1929, of the combined sound and picture theatre release print, however, made it imperative to study the technical aspects of the process involved since any marked departure from the recommended practice was at once apparent to the ear and for this, of course, no latitude

on artistic grounds could be tolerated. Quite apart from the impact of sound, however, control is necessary in the handling of motion picture film if objectionable features such as excessive grain, poor definition and too harsh or too soft a result are to be avoided in the picture. Control is also necessary if full and proper advantage is to be taken of improved film stocks, processing techniques and associated equipment as and when these become available.

Briefly stated, the purpose of technical control is to discover the optimum conditions for routine working within the laboratory and having established these to ensure that the minimum deviation is allowed to intrude. Since the operation of film processing is continuous it is pointless to deny that deviations do occur but they can be kept to satisfactorily low levels if due attention be paid to the points that are made in the paragraphs which follow.

#### **Picture Negative.**

The camera-man may make use of any one of a number of negative film stocks, each of which may call for a given degree of development. The job of the laboratory is to determine the right degree of development and to advise the camera-man on his exposure levels. Once he has acted on this information he must be able to rely on the laboratory to maintain consistent conditions for all succeeding negatives sent in by him.

The degree of development of a negative depends on such factors as:

- (a) Developer composition.
- (b) Time of development.
- (c) Temperature of development.
- (d) Rate of circulation of developer.

Of these factors, the first depends on the composition of the original bath and this in turn on the chemical nature and purity of the ingredients used. It depends also on the rate at which the active constituents are used up or exhausted during the process of development of the film passed through the bath, as well as on the accumulation of soluble bromide therein. The developer composition can be controlled by the addi-



tion of a suitable replenisher or "boost" solution, either continuously or periodically, and checked by chemical analysis of the bath. Details of analytical procedures have been described from time to time in the technical press and are summarised by the author in the April issue of the journal.

The other three factors are a function of the developing machine and can usually only be controlled by suitable mechanical adjustments. It should be noted that the temperature of the developer is dependent to some extent on the surrounding room temperature and this assumes greater importance in machines where the film travel is not wholly below the developer surface; control of ambient air temperature is therefore desirable. Poor circulation of the developer may result in streaks and patches due to the local accumulation of developer exhaustion products such as bromide, and known as "chemical drag."

Provided all these factors can be satisfactorily controlled there is no advantage to be gained in being able to watch the progress of development of the image in the dark-room itself and the modern trend is towards the design of equipment for daylight operation, so doing away with one of the bugbears of laboratory operation.

#### **Sound Negative.**

Sound negatives may be recorded on any one of a number of film stocks, each of which, as with picture negative, may call for a given degree of development. The factors already mentioned affect the sound negative quality equally as they do the picture negative.

The sound recordist relies on laboratory data for setting and checking the illumination given by his equipment and in so doing must, of course, assume that laboratory conditions are uniform and reliable. He relies on the laboratory, too, for checking the various recording stocks in use and particularly to compensate for any batch-to-batch variations from one emulsion to another.

#### **Printing.**

Before the picture negative can be printed,



(Courtesy of Associated British-Pathé)

*The Western Electric densitometer is designed to read diffuse densities as recommended by the current British and American Standards Specifications. It operates photo-electrically and is particularly valuable for checking sensitometer strips and sound tracks.*

it must be graded or timed. This may be carried out visually or by the aid of a device such as the "Cinex" timer. Visual grading pre-supposes the existence of standard printing and developing conditions within the laboratory and any change in these conditions, either deliberate or accidental, cannot be easily compensated by the grader. His work is further complicated by any lack of uniformity that may exist between the various printing machines used. If a "Cinex" timer or similar device be employed it is important that this be calibrated in terms of the light changes given by the printing machines and periodic checks must be made to verify this condition.

Sound negatives can be graded visually or by the use of a densitometer. More accurate results are to be obtained through cross-modulation or inter-modulation tests.

A variety of film stocks is used for print-

ing and includes News, Cine Positive, Fine-Grain Release Positive, Duplicating Positive ("Lavender" or "Red Master"), Duplicating Negative (Grey-Back or Fine-Grain) as well as 16 mm. stocks for contact or reduction printing. The particular exposure and development conditions for each of these must be assessed and maintained and due allowance made for any batch-to-batch speed or contrast variations that may be found from one emulsion number to another.

The exposure received by the film in the

photometric means. Where more than one type of printing machine is employed the various lamp intensity levels and light changes must be inter-related with one another so that similar results will be obtained from any given negative. This is particularly important on multiple printing machines employing more than one light-source where the exposure level at each gate must be held uniform and constant. Moreover, in producing combined sound and picture prints the relationship between the sound and picture lamp intensities must be



*With daylight developing machines (such as the bank of five Debie "Multiplex" machines pictured here) it is impossible to watch the progress of the film through the developer solution. Complete reliance has therefore to be placed on any system of control designed to cover the processing operations.*

(Courtesy of Associated British-Pathé)

printing machine is dependent upon such factors as:

- (a) Printer lamp intensity.
- (b) Printer lamp colour (including use of filters, etc.)
- (c) Rate of film travel.
- (d) Order of magnitude of exposure time.

Factors (a) and (b) are controlled largely by the lamp rating and voltage applied. The lamp intensity at the printing aperture is dependent also on the age of the lamp and on its distance from the aperture, and must be checked by photographic or

maintained at a definite, pre-determined level.

A selenium barrier type photocell may be used in conjunction with a sensitive, direct-reading millimeter to provide a simple yet satisfactory check for printing machine lamp intensities. When carrying out a check the meter needle is brought back to its "standard" position by suitable adjustment of either the lamp position or of the voltage applied to the lamp.

Where the colour temperature of the lamp is important, as for example in printing colour sensitive films, suitable control can be exercised by the use of appropriate filters



used over the photo-cell when setting the lamp position. Usually, in such cases it is inexpedient to control the lamp brightness through the applied voltage because of the associated change in colour temperature thus introduced.

The rate of film travel (factor (c) ) is a function of the printing machine and must be maintained at a uniform value. Here it must be remembered that if the electrical supply is from a fluctuating source any variation in mains frequency will be reflected in varying motor speeds and as such will affect the rate of film travel—and hence the exposure—unless due precautions be taken to offset this effect. Printing machine speeds may be checked by timing the film past the printing gate or more simply by the use of a stroboscope of the repeating high-intensity flash variety.

Factor (d) assumes importance when the film stock to be printed exhibits more or less reciprocity failure as compared with the film stocks normally handled. As such it can give rise to quite puzzling anomalies in exposure especially when the normal sensitometric tests are made on a time-scale sensitometer.

It is also important in the testing of sound recording stocks since the type of exposure given in the camera differs markedly from that of the normal sensitometric equipment.

Other factors of importance in printing that call for regular inspection and control are: uniformity of illumination over the printing aperture; accuracy of light changes where resistance control in the lamp circuit is employed; definition of image and the avoidance of slippage in continuous printers, especially for sound, where this may introduce sibilance and "wow," plus a general falling-off in tone reproduction quality.

The development of the exposed positive film is attended by all the factors already mentioned for negative film. An added complication is the greater susceptibility of positive film to aerial fog and this is of importance in developing machines where the film travel is not wholly below the surface of the developer solution. The fact, too, that positive film is normally developed

to a much higher contrast than negative film means that any irregularities that occur during development through temperature variation or unevenness of circulation will be more readily apparent on positive than on negative film. This should not be taken to imply that control of these factors is not so important with negative film; on the contrary, its importance can scarcely be over-emphasised since any irregularities introduced into the negative film will be greatly magnified in the positive print and when once introduced cannot subsequently be removed.

### Screening.

Since the judging of the final print as seen on the screen is to some extent influenced by artistic impressions, it is difficult to provide a standard that will be generally acceptable for all viewers. There may, on the one hand, be the studio personnel responsible for shooting the picture who are anxious to see a faithful reproduction on the screen of the "mood" they set out to interpret; on the other hand there may well be the limitation applied by the exhibitor who because of his restricted screen brightness level, demands a print some 2 or 3 printer points lighter than these others would be willing to accept. If the audience who pay to see the picture have any views on the matter as well, they are normally, and perhaps fortunately, expressed to some quarter not in direct touch with the laboratory.

In theory, at least, the laboratory should be free of the arguments that revolve about this vexed point of print density. Provided due control has been exercised in both the printing and developing processes outlined earlier on, it should be possible to reproduce any given result in all the copies of a particular film within satisfactorily close limits. In practice, however, this is not so, one of the principal reasons being the simple fact that identical prints may appear to be markedly different if the screening conditions are not maintained constant. Thus, for a given size of picture, the projector lamp can affect the result by a change in

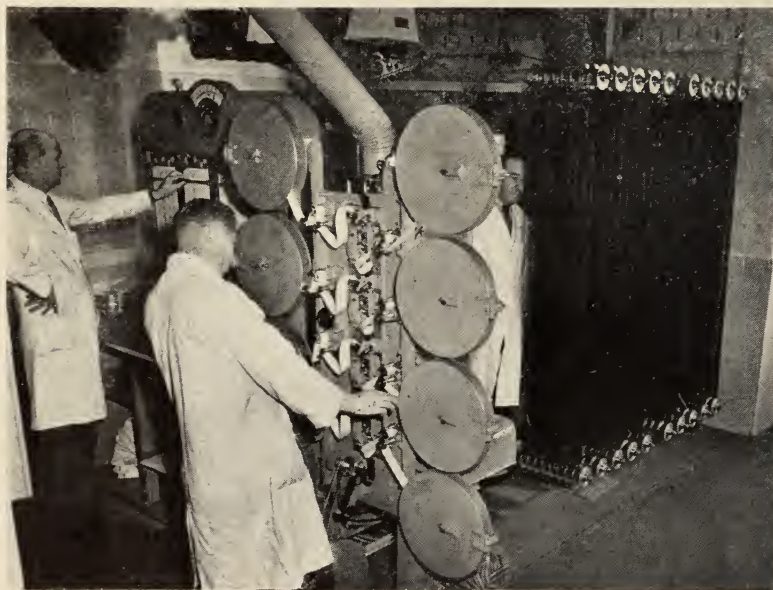


intensity or colour, while the screen can do likewise by a change in reflectance or colour. The projector lens, too, can affect the result on the screen by variable definition and light absorption.

The obvious solution would seem to be to arrange for all cinemas to adopt and abide by the recommendations made by the British Standards Institute to fix the screen brightness level within a certain, recommended, range (B.S. 1404: 1947). To do this, apparently, is in many cases quite impractical and there would seem to be no immediate hope of solving this unfortunate problem, the burden of which, rightly or

### Sensitometry.

Before the introduction of sound, control of negative and positive film quality was usually carried out by visual inspection both during development and on subsequent screening. The standard of photographic quality obtained in this way depended upon the skill and judgment of those whose duty it was to examine the finished products, and with experienced operators tolerably good and reproducible results were achieved. The producible results were achieved. The advent of sound, however, rendered such methods obsolete as they lack the precision necessary to ensure completely satisfactory



*The printing machine shown here operates with the negative joined together in one continuous loop. Four separate printing apertures are provided one above the other so enabling a high rate of output to be obtained. With this type of machine it is of special importance to ensure that identical exposures are given at each of the four printer gate apertures.*

(Courtesy of Associated British Pathé)

wrongly, is borne largely by the processing laboratories.

### Systems of control.

The two general systems of technical control used in the laboratory are:

- (a) Sensitometric, or photographic checks.
- (b) Chemical analysis and pH measurement.

Physical checks are sometimes used as well but generally speaking to a much less extent than either of the others.

results. Sensitometric methods of control have therefore largely replaced visual methods as by their use a high degree of perfection can be obtained.

In essence the technique consists in the production of strips of film which have been given graduated series of accurately known and reproducible time—or intensity—scale exposures by means of an instrument known as a "sensitometer." The Eastman Kodak Type "2b" sensitometer is perhaps the best known example in use to-day. This is a time-scale instrument and in this connection it may be mentioned that all printing

machine exposures, like camera exposures, are of the intensity-scale variety; if reciprocity failure characteristics of any one emulsion to be used in the laboratory assume significant proportions then this one factor alone can introduce considerable complications in its control.

The sensitometer strips are developed under known or controlled conditions and the developed silver images measured by means of an opacimeter, or "desitometer." From the results so obtained information may be gained regarding the film speed, fog and contrast, the developer activity, and so on. Here again the results are open to variable interpretation since although a standard of density measurement exists it is doubtful if all the current instruments subscribe to it uniformly closely. This particular factor may be the cause of recurrent discrepancies between one laboratory and another and if not allowed for in some way may easily spread unwonted confusion.

#### **Chemical Analysis.**

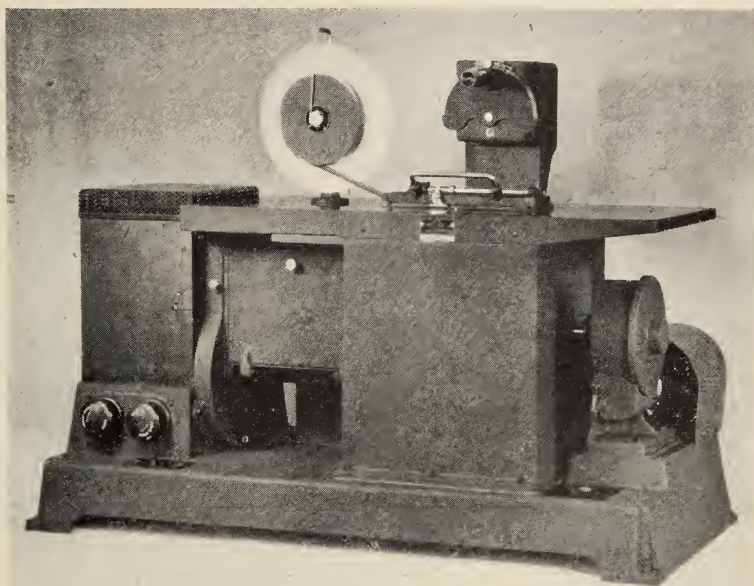
Within recent years it has become the practice to supplement the purely photographic or sensitometric tests by means of chemical analysis of the various solutions used in the film processing laboratories. In general, the results of such analyses are directed towards the control of developer solution composition but an attractive if secondary consideration lies in the considerable economy of chemicals that can be achieved thereby.

Measurement of developer pH, or degree of alkalinity, may also usefully be carried out to give a quick check on solution performance but is rarely sufficient by itself. Not only are the results open to variable

interpretation, but they may even, if unsupported by other, more reliable data, suggest the wrong course of action.

#### **Conclusion.**

The purpose of this article is to lift the veil on what goes on in the control department of a film processing laboratory. It will have achieved its purpose if it succeeds in conveying the impression that the job of control is a very real one indeed and that if it were not undertaken seriously, chaos would inevitably result. Properly carried out, the application of technical control



*The Eastman Kodak Type "2 B" Sensitometer*

should make it unnecessary to screen the work as it comes off the developing machines in order to check on its quality. This is perfectly true and those who have tried, or still try, the expedient of retrospective control by screening all their tests know how expensive and unreliable such a process can be.

Acknowledgment is made to the Fountain Press for permission to reproduce material from the "Cine Data Book" by the author.



# PROBLEMS OF STORING FILM FOR ARCHIVE PURPOSES

H. G. Brown (Associate)\*

*Read to a joint meeting of the British Kinematograph Society and the British Film Academy on March 5, 1952.*

**M**Y purpose is to present a picture of the task of storing film and to describe such solutions to the problems as have been devised. In doing so it must be explained that what is said refers to the experience of the National Film Library. There are other bodies concerned with film archives. Similar libraries exist in a number of other countries, and in this country the Imperial War Museum, and the War Office, are concerned with film preservation. Indeed, all Government Departments have a responsibility for keeping their films until the Master of the Rolls gives permission for their destruction or other disposal.

The National Film Library's preservation work is carried out under the guidance of an expert Technical Committee consisting of Mr. Denis Wratten, Mr. S. A. Ashmore, Mr. A. Barclay, Mr. L. N. Duguid, Dr. G. B. Harrison, Mr. W. J. Maloney, Dr. H. J. Plenderleith and Mr. C. Winterman.

Mr. Denis Wratten was also a member of a committee which was set up by the British Kinematograph Society, at the request of the British Film Institute, to advise the Institute on the technical matters connected with the establishment of a National Film Library. This Committee's report<sup>1</sup> was published in 1934, and I shall have occasion to refer to this report several times for its recommendations are still the foundation of our practice. The storing of films in an archive or museum, may be regarded as a matter of protecting the films indefinitely from a number of hazards which threaten to destroy them. It is important to understand that when we say "indefinitely" we are thinking in terms of at least hundreds of years. These hazards are:

(1) Fire.

(2) Physical wear and tear.

(3) Damage by water.

(4) The inherent chemical instability of nitrate film base.

I propose to say something about each of these. Firstly about the conflicting claims of the need to provide access to the films and the necessity of avoiding damage. It is useless to have a collection of films, however valuable and interesting, if it is never to be possible for anyone to see them. Indeed the real value of an archive may be measured by the amount of use which can be made of it, but whenever a film passes through any machine for viewing or printing, it suffers some degree of wear. The normal means of viewing films is, of course, to project them on the screen, but of all film handling equipment a projector imposes most strain and the greatest risk of accidental damage. Of almost every film in the Library, there is only one copy; and whether this copy is negative or positive, or whether it is in good or poor condition, being irreplaceable, its projection is a risk which we cannot afford to take, for eventually it would be worn out and the contained subject matter lost to subsequent would-be users. Cost precludes the making of a duplicate of every film which anyone desires to see. The best compromise available to us is that when viewing is necessary this is done on a continuous motion editing machine on which a postcard picture is seen. Viewing on this as compared with projection has three advantages in terms of protection of film from wear and risk of damage:

(1) The film runs on a single continuously moving sprocket, which imposes less strain on perforations than the several sprockets and intermittent

\*National Film Library.



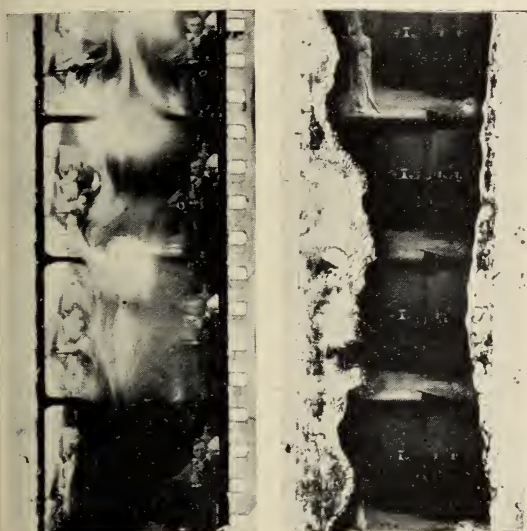
motion of a projector. It should be borne in mind that the film may be already old, and its perforations somewhat torn.

- (2) The heating of film by projection illuminants is considerable. Every projectionist knows that the film is sensibly warm when he takes it from the bottom spool box. The heat reaching the film from the small lamp of the editing machine is negligible.
- (3) The editing machine is under the intimate control of the user and can

ensuing remarks refer to nitrate film. I shall refer to safety film later.

It is common knowledge that nitrate film is dangerously inflammable, but if we look more closely into this we find that its exceptional danger is due to three facts:

- (1) It rapidly decomposes upon being subjected to quite a small amount of heat. A temperature of 230° F. may be sufficient to ignite even new film.<sup>2</sup> Very old film will burn at a much lower temperature, and I shall refer to that later.
- (2) The gases evolved from the decom-



(a)

(b)

be stopped instantly if there is any trouble. Even so there are some films which are in too poor a condition to view, even by this means, and are thus quite inaccessible until they are duped.

#### The Nature of the Fire Hazard.

Although the industry now almost completely uses safety base, until a few months ago virtually all standard film was made on nitrate stock, and thus the bulk of film in any archive is now on inflammable base; for many years we shall have to continue to store a quantity of this material, and the

position of themselves form an inflammable mixture. That is to say, oxydising agents are among the gases produced so that once ignited, combustion can continue independently of an external supply of oxygen. In this it possesses explosive properties.

- (3) These gases, upon burning, generate a fierce heat.

The result is that a film fire cannot be extinguished by the usual means of fire fighting, i.e. the principle of exclusion of air, since the decomposing film supplies oxygen from its own material. The heat generated

Fig. 1.

- (a) Specimen of sticky film showing flux-like distortion of image.
- (b) Specimen of film showing damage by water, where the image is destroyed from the edge inwards.

means that any nearby film will also become involved, unless it is effectively insulated.

### Nature of Decomposition.

Quite a small degree of heat will cause nitrate film to decompose rapidly, but further than this, the film at normal temperature decomposes slowly. In other words, it is an inherently unstable compound, and in this lies the most serious problem which faces any archive.

Emphasis must be laid on the fact that film consists of grains of silver suspended in gelatin, and more commonly known as "the emulsion"; and the support or "base" on which it is carried. The emulsion is recognised to have very long lasting characteristics if it is properly processed.<sup>1</sup> It is the nitro-cellulose base which decomposes. More specifically what happens is this:—

From the time of its manufacture, the base begins to disintegrate, to break down into the chemically simpler substances of which it is composed, and gases, mostly oxides of nitrogen are given off.<sup>3</sup> At first this occurs very slowly and in normal use the vapours are able to escape. Naturally, passing film through projectors, or printers, and rewinding are all a form of ventilation. Later the rate of production of gases increases, and probably the film is left untouched in its can for some time, so that in addition to an increasing rate of production, there is less opportunity for gases to escape. The gases eventually enter into combination with the gelatin of the emulsion, forming a substance which possesses a great affinity for moisture. It will readily absorb moisture which is normally present in the atmosphere, and then it comes to a sticky state. This becomes more and more strongly acid, and attacks the silver image, which fades completely. The age which a film attains before reaching this state varies, and a number of factors seem to influence its life. Detail of manufacturing process is one. Stock produced by certain manufacturers at about certain dates seems to reach this condition while film of other manufacture at the same date is still good.

I have mentioned that projection of film provides ventilation, and we have observed that films which have been packed in tins and never used are found to have come to the end of their lives before other copies of the same film, which have been much used. Conditions of temperature and humidity in which the film is stored are important factors. A serious practical fact is that at the time the film becomes sticky the base itself shows no change. It is still clear, colourless and reasonably supple. Not until the emulsion is sticky and the picture destroyed does the film look different or feel different.

It might seem that if all the vapours produced were able to immediately escape, or if the film were kept in dry condition, that the problem would be evaded, but no satisfactory solution is possible on these lines; indeed we might be in a still worse position, for the sticky condition is not the last stage of decomposition. Subsequently, the film base, which at the onset of the "sticky" stage is physically and optically in good condition, proceeds to deteriorate to a brittle and friable state, becoming an even greater fire hazard, since in this condition it may ignite at a temperature as low as 106°F.<sup>4</sup>

It may be interesting to note that, while in the sticky condition, film is sometimes quite difficult to burn. It is well known that uncoated film burns more readily than that which carries an emulsion; the emulsion tending to inhibit the combustion. When the emulsion is heavily charged with moisture, than inhibition seems to be still greater. It is possible to avoid the emulsion becoming sticky by keeping the film in very dry conditions. A sticky film placed in a dry atmosphere will lose its moisture and the emulsion become firm again, but a film kept in dry conditions becomes so brittle as to be almost impossible to handle.

I will take this opportunity to make quite clear the distinction between the sticky condition of the reel and another cause of damage, because the results of the two look very much alike at first glance. This reel has been ruined because it has been in contact with water. I have just taken it from a

new tin ; but the original tin was eaten with rust. It was, I imagine, with something like this in mind, that the B.K.S. Committee recommended the use of containers other than the usual tinned sheet-iron ones. Various circumstances have led us to continue to use such cans; and under the conditions which exist in our vaults, and with constant surveillance, no damage is likely to ensue from this cause. One wonders how many films have been lost through being just put away and forgotten. In one place from which

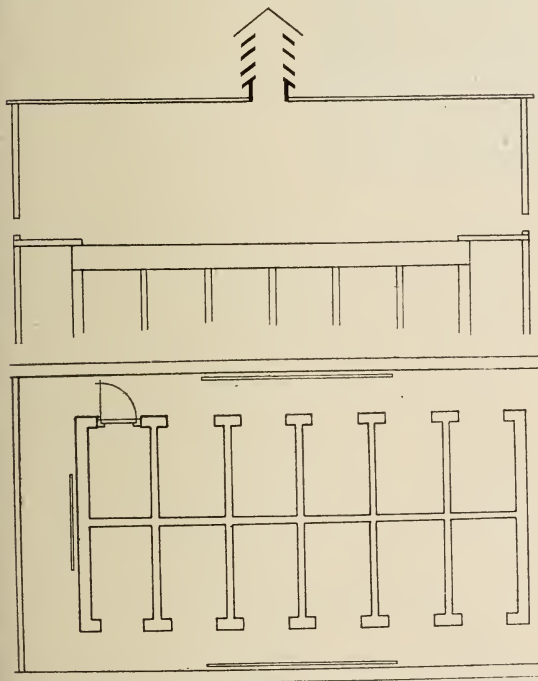


Fig. 2.

(a) Side elevation of vault, showing louvred ventilator.  
(b) Plan of vault.

the Library obtained some films, one had to walk on duckboards because there was an inch or two of water on the floor. There is no problem here, as far as films which are in our hands are concerned, it is simply a matter of keeping a sound roof over their head.

#### Ideal Storage Conditions.

Our object therefore must be to provide, as far as possible, the conditions of store in which the inevitable decomposition pro-

ceeds most slowly. The conditions which were recommended by the B.K.S. Committee are:

- 1 A low and steady temperature. For maximum longevity the film should be kept at as low a temperature as possible above actual freezing point. 33°—40° F. was suggested.
- 2 A constant relative humidity of 50 per cent.

It is also necessary to permit the escape of decomposition gases. Therefore film cans must not be sealed, and for the same reason it is essential that the reels are not stored on edge ; for the weight of the reel then compresses the lower layers of film together, and the vapours cannot so easily escape. We have had several films which have been stored on edge, in which three or four frames of each of the outside layers have become sticky, while the rest of the film is in reproducible condition.

The maintenance of a temperature as low as that proposed would require refrigeration, which would be expensive and would lead to problems in handling. It would be impossible for staff to work continuously at such temperature, and it would be necessary to bring films into a warmer room whenever it was required to handle them for any purpose.

To bring films straight out of cold storage into a room at working temperature or to return it to cold storage directly from working temperature, would violate the requirement of steady temperature. Also bringing a cold film into a warm place would lead to a deposition of moisture on the film, which would, of course, be intolerable. Therefore a chamber in which the temperature of films could be raised or lowered over a range of about 30° F. during a period of hours, would be a vital provision under this arrangement. Moreover what would happen to a single reel when brought directly from cold storage, would also happen on a larger scale if warmer air from outside should enter the refrigerated store. The moisture vapour in the air would be condensed on all the surfaces; on the wall of the stores, on the





Fig. 3.  
View of exterior of vault.

film containers, and on the films themselves, since the film cans must not be sealed. So it would be useless only to provide refrigeration. It would be necessary to protect the building from stray entry of air, and to condition all air admitted. This would also be able to provide the ideal requirement of constant 50 per cent. Relative Humidity.

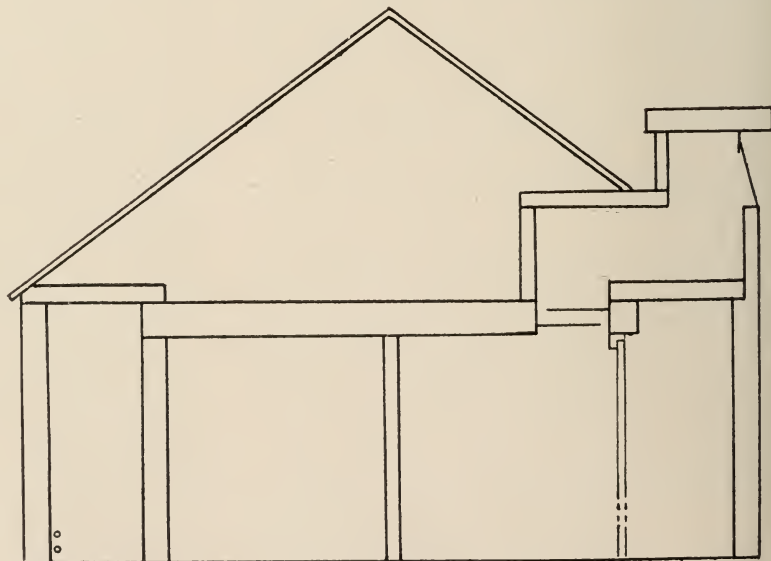
#### **Presently Achieved Conditions.**

With the large quantity of film which the National Film Library has to store, the

ideal conditions could only be achieved at prohibitive cost; and the wait of some hours before access to any film could be obtained, would be a practical handicap. Fortunately it is more important to maintain a steady temperature, than to maintain the temperature at any particular level.<sup>1</sup>

The Library, therefore, had to construct vaults which would provide conditions approaching as nearly as possible to the ideals, and particularly to steady temperature. Now it is much simpler, less expen-

Fig. 4.  
Side elevation of vault.



sive and more convenient for working purposes to maintain steadiness at a higher temperature and in the National Film Library vaults this is what is done. The target temperature is 55° F. and we have found it possible to remain within a few degrees of this over a period of several years; and only on two or three occasions has the temperature gone outside this range, during a period of extraordinary weather.

The vaults are arranged in blocks of twelve and are entirely enclosed within the building, the vaults being surrounded on all sides, and above, by a jacket of air. This air jacket serves in much the same way as the vacuum in a thermos flask; insulating the interior from changes in the temperature outside. In addition, to maintain the target temperature when the external temperature is lower, enclosed electric tubular heaters are installed in the corridor; and during the winter these keep the temperature within the vaults between 50° F. and 55° F. They are fitted with thermostatic controls which bring them in and out of action as required. During the summer when the outside temperature is higher than we desire, the interior remains cool.

The mechanism by which this is achieved is:

- 1 The insulating properties of the jacket of air in the corridor.
- 2 The movement and escape of heated air above the vault ceiling. At the centre of the ridge of the pitched roof (Fig. 2(a)) is a louvred ventilator and in each gable end, just above the level of the vault ceiling is a 9 inch square air brick. As the air in the roof space becomes warm it rises and escapes through the ventilator and cooler air enters through the air bricks to replace it.
- 3 To reduce the absorption of heat by the building, all the outside walls, and the roof, are painted white, in order to reflect as much as possible of the incident light and heat.

In addition to recording instruments, readings are taken three times daily with a

whirling hygrometer, to guide adjustment of thermostats and check the recording instruments.

These vaults, I should point out, had to be built during wartime, within the limits of the framework of an existing building, and without any tests or experiment. They have always been regarded by us as temporary, but they meet the steady temperature requirements remarkably well, which is fortunate since, like a number of wartime innovations, there seems to be little early prospect of replacing them with an ideal establishment. The humidity within the building is not closely controlled by this construction, and varies over a range of about 30 per cent. but it is found that violent fluctuations do not occur, and due to the steady temperature, dewpoint conditions never occur.

#### Fire Protection of Present Vaults.

Let us now consider the protection afforded by these vaults from effects of any fire. In this, the greatest danger from a film fire in an enclosed space is that of explosion of an accumulation of gases, which might damage the vault and spread the fire. It is therefore essential to provide adequate means of escape for the products of combustion (Figs. 3 and 4). The escape of gases is provided for by an opening 18 inches square in the ceiling of each vault, which leads through a brick built channel to the open air. The outside opening is closed by a metal flap, hinged at the bottom and held at the top by a dab of bitumen. In the event of a fire, heat would soften the bitumen permitting the flap to be fully opened by pressure of the gases. A further factor for which provision must be made is the escape of the vapours of the gradual spontaneous disintegration. A slow "breathing" of air through the vault is permitted by means of a small ventilator in the bottom of each vault door and an air brick in the side of the external part of the gas relief vent. Fire originating anywhere in one of these vaults would inevitably destroy the whole of the films in that vault.





Fig. 5. Experimental Store.

#### Experimental Storage Column.

In 1949, in co-operation with Messrs. Kodak, an experiment was conducted into the construction of a store which would limit a fire to the one reel of origin.<sup>5</sup> Storage columns which achieve this object have been designed by the American National Archives of Washington,<sup>6</sup> but these were of metallic construction and dependent upon a "cascade" or the formation of a "puddle" of water round each tin. It was an object of the National Film Library design to achieve individual reel isolation without dependence upon water supply and the risk on the one hand of failure of water supply and, on the other, of damage to film by water. The experimental store (Fig. 5), was designed by L. N. Duguid, a member of the Technical Committee, and was erected in the Harrow works of Messrs.

Kodak, Ltd., whose research staff carried out the tests. It consisted of a column of asbestos lined wooden drawers; each drawer large enough to hold a can containing 1,000 ft. of film. The back of the drawer was hinged, in order that pressure of gas should open it, thus avoiding explosion (Fig. 6). The drawers were separated by 1 inch thick wood, lined on the underside with asbestos. The brick structure supporting the drawers was constructed to form a flue through which gases would escape. The top of this flue was closed by a metal flap, similar to those on the existing vaults. At the bottom, a space of one drawer was left in order to produce a current of air up the flue to remove fumes. The tests carried out consisted of igniting a reel of film in one drawer and determining temperature changes in adjacent drawers. The greatest temperature recorded in an adjacent drawer was 121° F., while the external temperature was 47° F.—a rise of 74° F. Films in adjacent drawers remained undamaged.

As a result of the tests, two improvements were suggested. In the course of one of the tests some of the woodwork caught fire, and in order to avoid the possibility of this spreading, it was suggested that the woodwork be treated with a fire resisting chemical, or by making the construction of asbestos instead of wood. It was also found that some of the fumes escaped from the front of the drawer containing the ignited film. Since these fumes are poisonous it would be necessary to modify the drawers in order to provide a better fit at the front.

#### Artificial Ageing Tests.

Whatever success we have in protecting film from fire, water, physical damage and wear, its useful life is limited by the fact of the gradual decomposition, to the point, where, as I have mentioned, it becomes sticky. This process is most insidious. The film exhibits no visible signs of the imminence of the sticky condition; you just go to it one day and find all the layers stuck together, the images distorted or perhaps completely faded away. It was in 1942



that the Library was first brought up against this problem of films becoming sticky, when one of our films was found in this state. Very shortly after, Mr. C. Smith, of Kodak Research Department, devised an artificial ageing test using litmus as an indicator.<sup>7</sup> In 1946 we started using the present test, identical in principle,<sup>8</sup> but further developed by Mr. S. A. Ashmore, of the Government Laboratory, and a member of our Technical Committee. The test depends upon the controlled acceleration of the decomposition by application of heat. A disc of film  $\frac{1}{4}$  inch in diameter is punched out of the reel and dropped into the bottom of a small test tube. The top of the tube is then closed with a glass stopper, round which is wrapped a piece of filter paper, impregnated with an indicator dye, Alizarin Red, and moistened with glycerine and water. The stopper and paper make a close sliding fit in the test tube; and the tube is then heated in an air bath at a temperature of 134° C. The upper part of the tubes protrude from the top of the bath and are continuously visible. The time required for the development of acid vapours is revealed by bleaching of the lower edge of the paper. The tubes are watched for sixty minutes and the result is recorded as the number of minutes required for the colour change to occur (Fig 7).

It has not yet been found possible to relate precisely the number of minutes recorded as the result of this test, to a certain number of years of remaining life. There probably does not exist any precise relationship, but the results are a reliable guide to a certain minimum remaining life. Thus any film which at the end of sixty minutes gives no result, may safely be left for three years. At the end of this time, it is tested again. If the result is between forty and sixty minutes, the film is tested again after twelve months. If between twenty and forty minutes, after six months. Any film giving a test result under twenty minutes is regarded as unstable, since it is at this point that it becomes increasingly acid and is liable to become sticky.



Fig. 6.

Showing construction of draw in experimental store.

When we commenced to test all the films of the silent era we found 9 per cent. of those tested in the first year were unstable. As we have weeded out the existing unstable films, this proportion has dropped, until during 1951, when 1,700 tests were carried out on 1,143 films, only 5.6 per cent. of the films were found unstable. Without this test, the storage of films would be useless, since only by its agency are we able to anticipate the ruin of the film. Upon any film being found unstable, if the subject matter which it contains justifies its continued preservation, it is copied before it reaches the state in which copying is impossible.

The Library has three Selection Committees whose responsibility it is, to decide in each case, whether or not a film shall be duplicated. Since the inception of this testing programme, 448 films have been duplicated, which otherwise would have been lost.

#### Questions of Duping.

The making of dupes is a normal laboratory practice and we are told that it is possible to duplicate an original negative with practically no discernable losses, but this applies of course to normal current work. The physical condition and photographic quality of most of the old films in the National Film Library present additional and different problems. Although it

is not strictly a matter of storage, I think it may be of interest to enumerate some of them.

The Library consists of films made at all times since the beginning of the industry in 1895. The copies which we have of films prior to 1936 when the Library began to collect films, are just those which have chanced to survive. They are the copies which merchants have not scrapped and which private collectors have stored or passed among themselves, while some are negatives or prints which have lain forgotten in some studio vaults until perhaps a new occupier wanted the space. They consequently very often suffer from damage and defect. A common condition is great shrinkage. Excessive shrinkage in length means that the film does not run properly on sprockets and repeatedly rides up on the teeth and then slips back. The result, in a print made on a continuous printer may be seen here. In a specimen print about every fourth frame was blurred ; but worse was the factor of shrinkage in width so that in addition to the trouble just mentioned, when the perforations on one side are engaging with the sprocket teeth, the perforations on the other side do not reach to the proper position over the other row of sprocket teeth, and good contact between original and duplicating films is impossible, with a resultant loss of definition in the dupe and this difficulty arises with a step printer as well. Further, an old film is frequently shrunk unevenly across its width. This is another condition which makes good contact impossible.

#### **Variations in Perforations**

The industry is at present afflicted with double or even triple standards of perforations shape and size, but for many years at the beginning of the history of the industry there was almost no standard. Perforation shapes and sizes varied from make to maker, and even among the product of a manufacturer. Many of these earliest films will not run on any present type of printer. To duplicate these, Mr. H. D. Waley, of the British Film Institute, has constructed an

optical printer from cameras contemporary with the films, and has made duplicates of a great many of the very earliest films in the Library. There remain a number of films with which his apparatus has not succeeded, and there is still a field for further trial and experiment. Most of the old films of course, have perforations torn and often there are several frames with no perforations at all on one side.

There are also often many joins ; frequently they are excessively wide ; half a frame overlap is common, and we have found some overlapping two frames. Sometimes joins are unscrapped, and sometimes over-scrapped so that a white line or patch appears on one frame. We have found joins stuck together with glue and even stitched with sewing thread. All these must be repaired before the film is duped, and much of the staff's time is spent on this. When patching shrunk film, patching material shrunk to the same degree must be used in order that the perforations of the patch will match those of the film, and also because if new film is used its subsequent shrinkage will cause the film to buckle locally. With silent films which have no wide mask line in which the joins can be made, as is done with present standard sound films, every join must overlap into the picture itself.

Normally joins only occur at a change of scenes and the scene change helps to make the join un-noticeable; but when many joins appear during a scene they can be rather distracting, and we have one or two practices which help to render them less noticeable.

#### **Tinting and Toning**

Almost all the original films in the archives are used projection prints, which are not the type of copy to render the best dupe negatives. The highlights are too clear and the overall contrast too great, and of course nearly all are scratched and many of the scenes are tinted or toned. There may be some to whom a word about the distinction between tinting and toning may be welcome. Briefly: tinting is the effect produced by



putting a layer of colour over the whole picture, so that the "whites" become coloured, while the "blacks" are still black. In a toned image, the "whites" remain white, while the "blacks" are coloured. Some scenes were both tinted and toned. In this case when the "whites" are one colour and the "blacks" are another and this is duped into the present panchromatic F.G. Dupe Negative Stock, the resulting copy may reveal little contrast between them. Many of the dye tones used have faded severely so that the images are now only faint. In the face of all this the labora-

little quality as possible when duping, since a loss in tone rendering or definition which in itself is quite indiscernable may well become intolerable when repeated a number of times. For this reason some value may be found in photographic processes other than the silver halide type now in exclusive use in kinematography. I am thinking of the old collodion process and a new metal diazonium process which, it is claimed, can achieve a resolution several times greater than that attained by any present emulsions.<sup>8</sup>

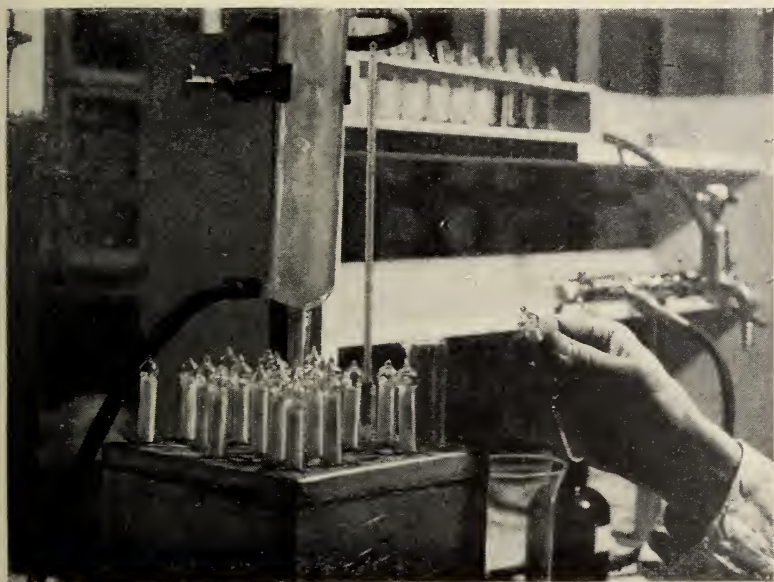


Fig. 7.  
*Artificial ageing test.*

tories are very co-operative and take a lot of trouble to get as good dupes as possible. This sort of work calls for departures from their normal routine, and departures which are apt not to be commercial propositions. A commercial laboratory cannot be expected to maintain printers which will fit excessively shrunk film, and the small perforations of early days. To do this the Library will almost certainly, at some time, have to provide its own printer.

In order to survive for the hundreds of years which we envisage, it may be necessary for a film to be duplicated several times. It is therefore clearly desirable to lose as

#### Problems of Colour Films

Apart from tinted films, although there were very few natural colour films during the silent period, there were many films naturalistically coloured; at first, freehand and later through stencils. The reproduction of the very pleasant effects which were often obtained by these means, is another problem which so far remains unsolved. Present colour stocks seem to be incapable of matching the rather delicate colours concerned. Even if a match were obtained, on an integral tripack material, it would probably be of little value since there is no assurance of the permanence of the dyes



produced in these processes. Solution of the problem of perpetuating the hand and stencil coloured film is being sought along the lines of obtaining an accurate account of the original means of production, in order to permit of eventual colouring of dupes by the same means. The fugitive dyes of tripack present another unsolved problem of themselves, for long term preservation purposes. They are sufficiently permanent for the commercial run of films but certainly some of the dyes of films of this type, made a few years ago are now fading.

### **Storage of Safety Film.**

All duplicates made for the Library are printed on safety base; and indeed have been since March, 1949. Since safety film is now being generally used, almost all of our future acquisitions will be on this material, and the best conditions in which to store acetate film becomes important for archive purposes. Safety film has some very valuable advantages for our purpose. Apart from the fact that it presents no extraordinary fire risk, its inherently superior chemical stability means that unlike nitrate it will not destroy itself within a short term of years. On the contrary, it is anticipated that it will have a useful life comparable with that of good rag paper, which may amount to hundreds of years. This is important because it will not be necessary to duplicate the film so frequently, and it is the slight degradations of quality, which are attendant upon duplicating, which, many times repeated, would eventually cause the image to deteriorate to the point where it would be useless. Its long life also raises the interesting speculation that with currently produced film, the factor limiting life will not be the base. It may be found that the limit of life will be imposed by the gelatin, which during the regime of nitrate base has been considered quite adequately permanent.

Since, until recently, there has been only very little safety film, there is not the same body of actual experience in its preservation as is the case with nitrate; but some

of the effects of unsuitable conditions are known. If stored in too high relative humidity the plasticizers are liable to separate from the base in crystalline form. If kept in too dry conditions it will become extremely brittle due to evaporation of plasticizers and moisture. There is agreement among investigators, that a relative humidity of 20 per cent. is a critical minimum. These investigators recommend storing in a relative humidity of the order of 50—55 per cent.<sup>9</sup> It is impossible without air conditioning to maintain constantly the required relative humidity throughout the vaults.

It is therefore proposed to condition the film in a small chamber in which the required temperature and humidity would be maintained. If the film has an excess of moisture it will lose it; if it is too dry it will absorb moisture. When it reaches the condition that it is neither losing nor absorbing, it is said to be in equilibrium. The film is then to be sealed in its can and placed in the main store. The most convenient way of sealing the cans is by means of a self adhesive tape. Such a tape requires three properties:

- (i) it must be resistant to the passage of vapour;
- (ii) the tape must be sufficiently mouldable to wrap round the ridges of the can to make a close seal; and
- (iii) the adhesive must retain its properties for a number of years.

It is also desirable, for reasons of convenience and economy that the tape should be able to be stripped off the tin without leaving any adhesive behind, and capable of being re-applied.

### **Tests for Water Vapour Permeability.**

At the request of the National Film Library a number of tapes of various materials were tested by the Chemical Inspectorate of the Ministry of Supply for water vapour permeability. Cellulose, paper and loose woven cloth tapes were all considered to be too permeable. The most satisfactory in this respect were found to be certain plastic

tapes and a waterproofed fabric tape developed for wartime protective packing purposes. Most of the plastic tapes, however, were not sufficiently mouldable to be made to adhere to the can without bubbles and wrinkles.

The most easily mouldable were the cloth tapes, and a polyvinyl chloride tape. To test the retention of adhesive property and possibility of re-applying tape after a period of time, we taped a number of cans and three years later removed the tapes. The paper tapes were all impossible to remove whole. The paper tore before the adhesive yielded. Cellulose and plastic tapes all peeled off leaving patches of adhesive remaining on the tin. Some adhesives had become hard and brittle. The cloth and waterproofed fabric tapes peeled off cleanly, and the adhesive remained in condition to permit re-applying the tape. One can has had its waterproofed fabric tape removed and replaced several times during the three years. This tape is the only one of the twelve tapes that we have tried which in addition to meeting satisfactorily all three requirements, is also reusable after being three years on a can. No tape, however, is capable of providing a perfect hermetic seal. If the humidities inside and outside the can are sufficiently different, there will be a slow passage of moisture, even through the tape, and it remains desirable to keep the air in the store at as near optimum conditions as possible.

#### Residual Hypo.

It has been suggested that the life of safety base may exceed that of the silver and gelatin image which it carries. At present this is just an interesting speculation. What is not a speculation, but a very pre-

sent reality is that if it is not properly processed the life of the image may be as short as two or three years. It is vital that all hypo be removed in the washing, for traces of tois, left in the film, can in two or three years cause loss of the image by fading and discolouration. Among the tests devised by C. Smith<sup>7</sup> was a test for residual hypo, applied to a punching of  $\frac{1}{4}$  inch diameter. This test is applied to all new film acquired by the Library, and it has proved its value. Although almost all current product proves to be free of hypo, there is occasionally some found. Recently among a number of sound tracks which we received were found some which contained some hypo, and indeed one reel was already discoloured. The test established which ones needed re-washing, and this was done immediately. Without the test these might well have been lost.

#### Conclusions.

In a paper whose subject has been the perpetuation of the past, perhaps we may conclude by looking briefly at possible problems of the future. Already, the widening use of colour photography presents its trouble to us, for we have found integral tripack colour films which are only about five years old, in which the cyan component has faded almost completely.

Magnetic recording is finding increasing use, and while there seems to be no early likelihood of the final track becoming magnetic, it may happen that the time will come when the permanence of magnetic records will be a matter of immediate concern.

The use of electronic cameras is being advocated. Possibly, this may lead to a method of telefilm recording, fundamentally different from present photographic films.

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## BOOK REVIEW

*Books reviewed may be seen in the Society's Library*

**JOHN BAIRD.** *Sydney Moseley. Odhams Press Ltd., pp. 264 + pl. 8, 16s.*

This biography is based on the original notes made by Baird for his own autobiography, and the documents collected by the author over his long association with Baird. The result is an authentic account of the inventor's life and work written in a graphic style which will appeal to all who are interested in the beginning of television.

The development of the science has been so rapid in the last few years that it will probably surprise many readers to learn that the Derby was televised by the Baird low-definition system in 1931 and broadcast on the 261 m. wavelength. A full account of this and many other pioneer

demonstrations is given in Mr. Moseley's vivacious book. If the first personal pronoun occurs with slightly irritating frequency, Mr. Moseley was after all the constant companion of Baird from the formation of his first commercial company until it was taken over by Gaumont-British.

Technical people know that J. L. Baird did not invent television, but he did give it the start in this country and he was the first to demonstrate that television was possible and practicable. Mr. Moseley's book has done his memory a service in giving a picture of this single-minded experimenter, who was often frustrated and misunderstood but who was nevertheless sincere and liked by all who knew him.

G. PARR.

## THE COUNCIL

*Summary of the meeting held on Wednesday, April 2, 1952, at 164, Shaftesbury Avenue, W.C. 2.*

**Present:** Mr. L. Knopp (*President*) in the Chair, and Messrs. B. Honri (*Vice-President*), H. S. Hind (*Deputy Vice-President*), R. J. T. Brown (*Hon. Secretary*), N. Leever (*Hon. Treasurer*), D. F. Cantlay, F. S. Hawkins, R. E. Pulman and S. A. Stevens.

**In Attendance:** Miss J. Poynton (*Secretary*).

**Apologies for Absence.**—Apologies for absence were received from the Past President and Mr. T. W. Howard.

**Television.**—The successful activities of the Tele-Kine Group and the growing demand from

members have resulted in the inauguration of a Television Division of the Society. Applications for enrolment should be made on the appropriate form, obtainable from the Secretary.

**1952 Honours.**—The Hon. Fellowship is conferred on:

The Rt. Hon. Viscount Swinton, P.G., G.B.E., C.H., M.C., and

Sir Philip Warter.

The Fellowship is conferred on:

Messrs. R. J. T. Brown, J. H. R. Coote, G. J. Craig, D. Forrester and S. A. Stevens.



## COMMITTEE REPORTS

**Membership Committee.**—The following are elected:

Sam E. Shroff (Member), 43, Cecil Avenue, Wembley, Middlesex.

Sidney Noel Ward-Ellison (Associate), Capitol Cinema, Meanwood, Leeds, 6.

Brian John Marshall (Associate), Mercia Films, Ltd., Wembley Film Studios, Wembley, Middlesex.

Joyce Messenger (Associate), Mercia Film Productions, Ltd., Wembley Park, Middlesex.

Richard Spurrier Meakin (Associate), British Broadcasting Corporation.

William Thomas Coulling (Member), Festival of Britain Office, Victory House, Regent Street, London, W.1.

Jack Stanley Whincup (Associate), Associated Tower Cinemas, Ltd., 41, Park Lane, Leeds, 1.

Peter Crossfield (Associate), Associated Tower Cinemas, Ltd., 41, Park Lane, Leeds, 1.

Stanley Sedgwick (Associate), Crescent Cinema, Dewsbury Road, Leeds.

Albert Charles Jesse Bolton (Member), RKO Radio Pictures, Ltd., 2-4, Dean Street, London, W.1.

The following is transferred from Associateship to Membership:

John Errol Rankin McDougall, Associated Screen Studios, 2000, Northcliffe Avenue, Montreal, Canada.

The resignation of one Associate was noted with regret.—*Report received and adopted.*

**International Relations Committee.**—The work of appointing Society representatives abroad is going forward. Mr. E. W. Wingrove, Secretary of the B.F.P.A., is co-opted to the Committee.—

*Report received and adopted.*

**K.R.S. Film Damage Advisory Committee.**—Mr. R. J. T. Brown is appointed to represent the Society on the above Committee.

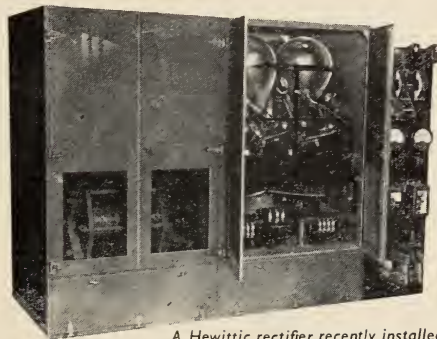
The proceedings then terminated.

Members are urged to keep their fellow members informed of their activities through the medium of *British Kinematography*.

Small announcements will be accepted from Members and Associates. Rate, 4d. per word, plus 2s. for Box No. if required (except for Situations Wanted). Trade advertisements, other than Situations Vacant, not accepted.

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JUNE, 1952

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## INTERNATIONAL RELATIONS COMMITTEE

IT is true to say that the first real appreciation of the scope and possibilities of the Foreign Relations Committee came about a year ago. At that time the Festival of Britain was attracting an unusually large number of visitors from abroad, and in order to maintain liaison between the Society and the many film technicians amongst these visitors, the Committee was reconstituted on a more active basis.

Under the new title of "International Relations Committee," it has extended its activities into many territories which had previously been neglected. The Society has members in practically every film producing country in the world. In order to maintain close touch with them, local representatives have been appointed in the major production centres through

whom information of achievements in technique and equipment design will be disseminated. As well as being responsible for the exchange of information, when desired the representatives will contribute informed reports on local or regional conditions affecting film production. These will, from time to time, be published in the Journal.

The nucleus of a world wide network of technicians willing to participate in Society affairs has been formed and the Committee is anxious to consider any suggestions as to how this organisation may be used more effectively to assist members in all parts of the world.

NORMAN LEEVERS,  
Chairman.

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## NEWLY ELECTED HON. FELLOWS AND FELLOWS

### Hon. Fellows



**Viscount Swinton, P.C., G.B.E., C.H., M.C.,  
the Chancellor of the Duchy of Lancaster.**

In 1926, British film production was at a very low ebb. The studios were out-of-date and the number of films produced fell as low as six per annum. Lord Swinton (who was then Sir Philip Cunliffe Lister), as President of the Board of Trade, conceived, drafted and piloted the Cinematograph Films Act, 1927, which abolished blind and block booking of films and introduced the British Film Quota for renters and exhibitors.

As a direct result of this Act, modern film studios were built and the British motion picture industry has expanded and reached a stage of technical excellence equal to or superior to any in the world.

*Photograph : Elliott & Fry, Ltd.*

### Sir Philip Warter

For the influence he has exerted towards the betterment of the British motion picture industry by virtue of his efforts within the British Film Producers Association and the Films Council, and as Chairman of The Associated British Picture Corporation.

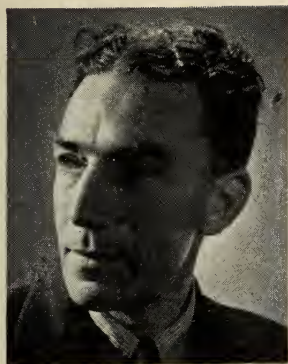
Under his guidance the new A.B.P.C. Studios at Elstree were built and a continuous programme of British Films has been made during the last four years.

Since joining the Board of A.B.P.C. in 1941, Sir Philip has shown a keen appreciation of all the problems to be met in order to keep in being a live and virile industry.



*Photograph : Fayer*

## Fellows

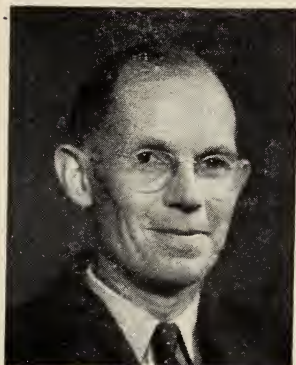


R. J. T. BROWN



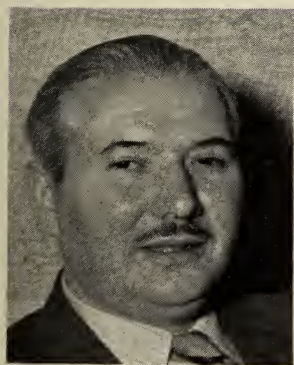
*Photograph : J. Scott Bushe*

J. H. R. COOTE

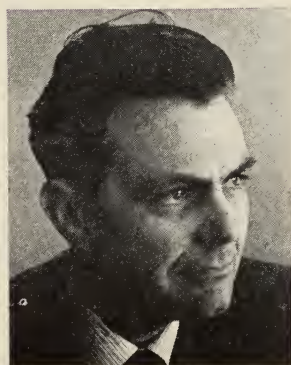


*Photograph : Godfrey Lane*

G. J. CRAIG



D. FORRESTER



S. A. STEVENS

## Fellowship Citations

### Richard J. T. Brown, D.S.C., B.Sc.

For his technical work over a period of ten years in the development of sound recording equipment, 16mm. projection equipment and service radar, also for his contribution

to the dissemination of technical knowledge through his leadership of several B.K.S. committees.

### Jack Howard Roy Coote, F.R.P.S.

He is known throughout the British motion picture industry for his persistent and courageous efforts to effect improvements in the apparatus and the technique of colour photography and reproduction. This work has

often been carried out under great difficulties.

Some of the results of his work are known by the great number of patents granted to him and by the authoritative papers which he has presented before the Society.

### Gordon Jeffrey Craig, O.B.E.

For research and technical development work during more than fifteen years association with the industry. Particularly in respect of his basic research into methods of rapidly drying motion picture film for tele-

vision purposes, for installing and completely organising the R.A.F. Film Section of the South East Asian Command, and, more recently, for work in connection with the development of motion picture safety film.

### Donald Forrester

For occupying a position of eminence in the British motion picture industry for 18 years as Managing and Technical Director of Films and Equipments, Ltd. For being responsible for research work and the development of motion picture apparatus for both

sound and picture reproduction. For his development of kinematographic apparatus for scientific purposes covering the aeronautical, medical and geo-physical fields where equipment of his specification is now being used successfully.

### S. A. Stevens, B.Sc. (Eng.), A.C.G.I., D.I.C., M.I.E.E.

For being the probable originator of the use of A.C. ballasted rectifiers for projector arc power supplies and thereby abolishing arc ballast resistances. For carrying out research work in connection with arc lamp power supplies since 1933, also for being

responsible for the Westinghouse patented systems for high overall efficiency and high power factor power conversion units for projector arcs, as well as Static Phase Converters for single to three phase power conversion.



## U.S. JOINT ARMY AND NAVY 16 mm. PROJECTOR SPECIFICATION

G. M. Wooller-Jennings

*Read to a meeting of the 16 mm. Film Division on March 12, 1952.*

**I** PROPOSE firstly to describe the events leading up to the development of this specification and its final acceptance, and the subsequent production of the equipment, a unit of which will be demonstrated later this evening.

In 1940, following the expansion of the Armed Services in the United States, plans were laid for the use, on a hitherto unprecedented scale, of 16 mm. film for training purposes. The successful use of film in this programme was, of course, dependent on the availability of suitable 16 mm. projectors and added impetus was given to the programme by the entry of the United States into the war.

I should mention here perhaps that objective testing of a number of commercial projectors had been carried out by the Bureau of Standards in 1942; the results of these tests of both mechanical and optical efficiency are most revealing as a comparison of the performance of equipment then available.<sup>1,2</sup> This work had followed the formation of a committee of the Society of Motion Picture Engineers in 1941 and the issue by this body of an excellent report laying down procedures for assessing the relative merits of 16 mm. equipment for educational purposes.<sup>3</sup>

During 1942-1945 more than 16,000 16mm. projectors were supplied to the Signal Corps—the agency responsible for the procurement of such equipment—by several commercial manufacturers, and were chosen in general, from models which had been subjected to a testing period of three weeks during which each machine was run continuously for five hundred hours. As these civilian machines were of different types and varying in performance their wide and heavy use, often in extremes of climatic conditions, raised problems in maintenance and in operation.

Towards the end of 1942, the Army Pictorial Service formed the Photographic Equipment Branch to consider the whole field of requirements but it was not until the following year that work began on the standardisation of 16 mm. projectors in the Pictorial Engineering and Research Laboratory. By 1944 the first effective move toward standardisation for military use was made with the issue of "Joint Army and Navy Specification JAN-P49." Immediately the war was over a contract for the development of prototypes was placed with the De Vry Corporation, and after exhaustive testing and modifications, the equipment emerged in its present form and was accepted as standard by the Signal Corps Technical Committee in February, 1950. The performance figures claimed by the manufacturers were in some cases significantly higher than required by the specification under reference. I do not intend to deal in detail with the Specification as most of its requirements have been embodied in American Standards Association publication, A.S.A. Z52.1.44. As Film Supervisor at the American Embassy, London, at that time, I suggested as soon I knew that this equipment was in production that two complete units be made available here for mobile operations where portability and reliability, in often difficult circumstances, were most important. These are the machines here this evening and are known by the manufacturers as the De Vry Armed Forces Equipment.

One of these projectors will be demonstrated; the side casing of the second has been removed so that the lay-out may be seen.

### General Description of Unit

Each unit is divided—rather like Caesar's Gaul—into three parts:

- (i) the projector proper (43½ lb.),

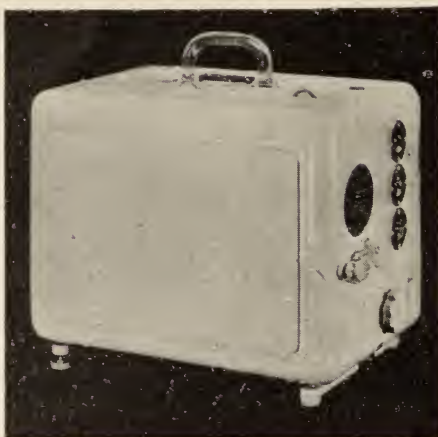


Fig. 1.

The DeVry Armed Forces three case 16mm. projector set, showing (top to bottom) amplifier, projector and loudspeaker.

- (ii) the amplifier (41 lb.),
- (iii) the loud-speaker (27½ lb.).

All cables and accessories are fitted into the cases which are of aluminium.

#### *Projector*

Sturdiness of construction of the projector is assured in the Specification which calls for its ability to withstand being dropped ten times on to a concrete floor from a height of eighteen inches. Much of this strength is due to the heavy main plate of cast aluminium which carries the mechanism, and this is padded against the case with neoprene foam rubber. (This material and rock-wool mats are used in the speaker case for acoustic insulation.)

The projector is fitted with a universal motor, speed controlled by a centrifugal governor and operating at a nominal 115 volts and 60 cycles although the tolerances are within the limits of 122 volts, 65 cycles and 108 volts, 50 cycles. A separate motor is used for cooling. No still-picture, reverse, or stop-motion devices are fitted in order that neither the projector nor the film be subjected to dangerously high temperatures; no part of the projector should be more than 50° F. above room temperature after 2 hours continuous running. This machine operates at 24 frames per second only, but has provision for film rewind. The power consumption of the projector is 1,000 watts, using a 750 watt, 25 hr. lamp.

#### *Amplifier*

The amplifier is for A.C. only and operates on the same tolerances as above, with a consumption of 175 watts to produce an output of 20 watts at less than 2 per cent distortion.

#### *Loudspeaker*

An Altec-Lansing 8-inch speaker of the permanent magnet type is used, having a voice-coil impedance of 16 ohms and power handling capacity of 25 watts. The cone is tropicalised, and frequency response is 100—7,000 c.p.s.

#### **Detailed Description**

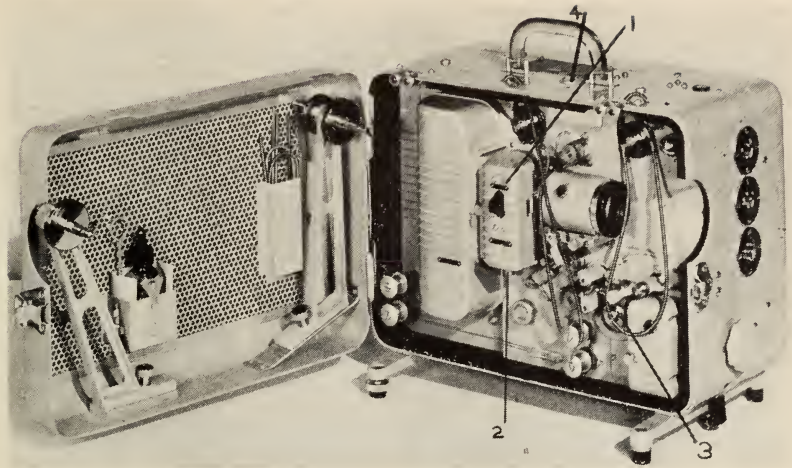
##### *Film Transport*

Let us now consider in more detail these



Fig. 2.

General view of projector showing (1) dowsor control, (2) framing knob, (3) sound scanning drum and (4) loop-reset button.



several parts of the complete unit which of course may be inspected later ; there are a number of points which are not perhaps obvious and, I feel, warrant special mention. The intermittent mechanism consists of a 3-tooth claw of which the centre tooth is known as the action tooth and is the only one actually touching the film during normal perfect sprocket-hole operation ; therefore it is this tooth which incurs the greatest wear and in which either a sapphire or carboloy insert is located. Sapphires, also set in the aperture plate, edge-guide the film against both the fixed rail and the

spring-loaded rail. Single-point lubrication is provided on the projector and the reservoir holds an oil supply sufficient for 100 hrs. continuous running.

#### Light Output

In terms of light output, the improved optical efficiency produces a screen illumination in excess of 320 lumens using a 750 watt 25 hr. lamp, or over 475 lumens with a 1,000 watt 10 hr. lamp. These outputs are above those required by the JAN-P49 Specification. Design improvements permit the use of F1-6 lenses up to four inches

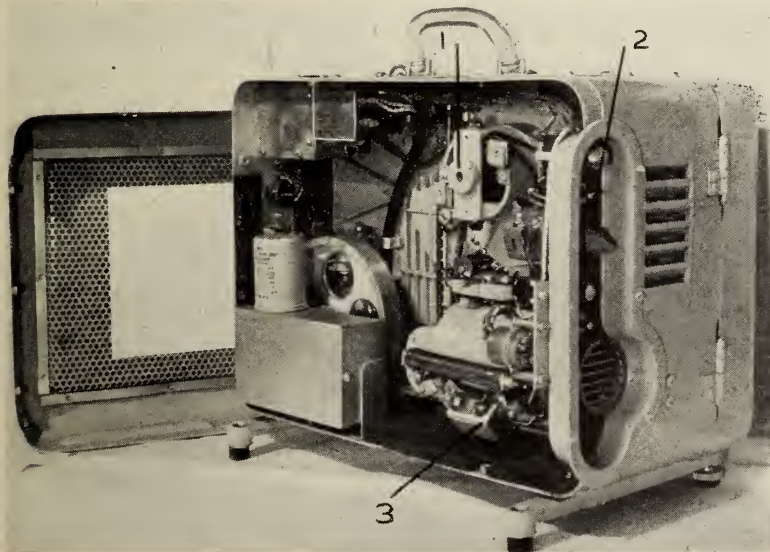


Fig. 3.

General view of projector assembly, showing (1) blower motor, (2) control panel, and (3) main driving motor on resilient mounting.



focal length without any reduction in the amount of projected light, and F1-9 lenses up to 5.4 inches focal length with only 30 per cent loss. (Ordinarily the light loss in commercial models is at least 30 per cent, using a focal length longer than two inches and may be as high as 80 per cent. with  $3\frac{1}{2}$  or 4 inch lenses.) This type of projector has been used to fill a 9 ft. by 12 ft. screen at 175 ft., the resulting picture being equal to that of a 16 mm. arc, using the old type optical system, at 125 ft. from the screen.

The adjustable lamp holder gives lever adjustment laterally and fore and aft, so to speak, in order to compensate for misalignment of the filament and thus re-align it with respect to the optical axis. A barrel shutter is fitted having two segments and giving 48 obscurations per second. Flicker is imperceptible when the screen illumination is reduced to 3 foot lamberts.

It is axiomatic for a professional film presentation that there should be no break-

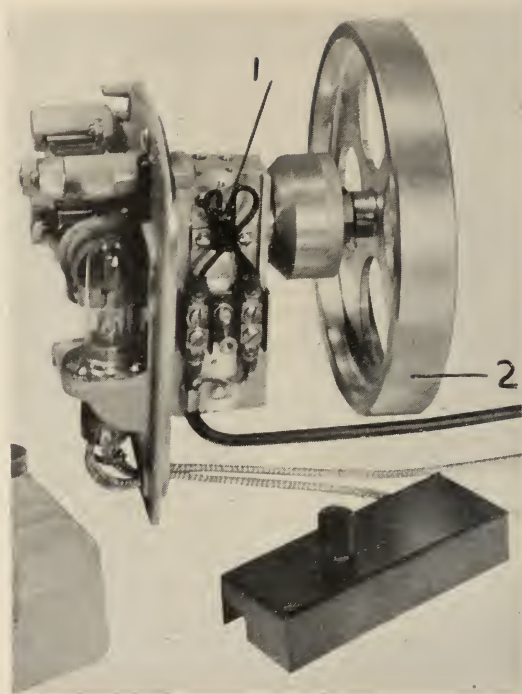


Fig. 4.

Close-up view of the sound head, showing (1) lead sulphide P.E.C., and (2) flywheel.

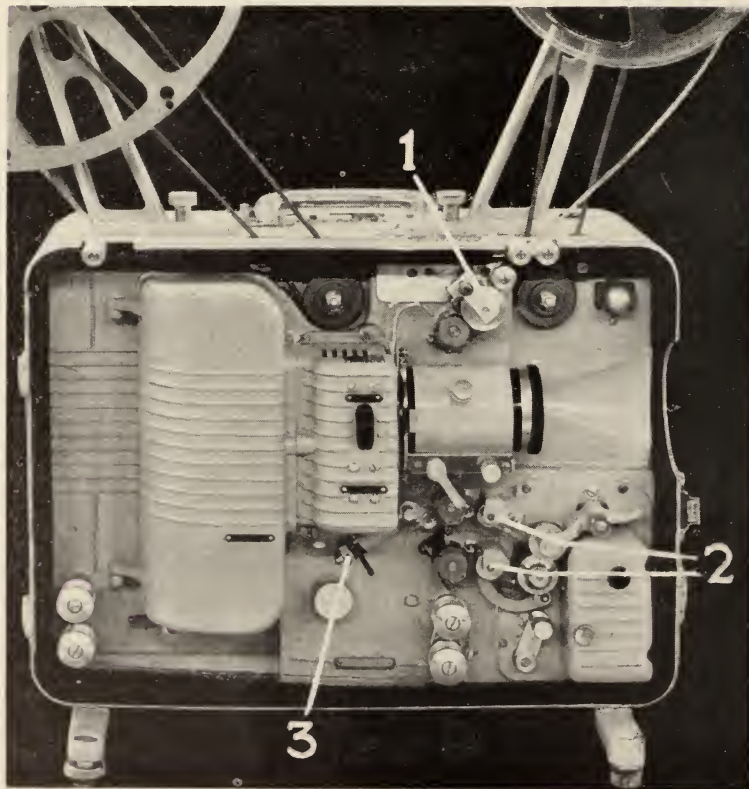


Fig. 5.

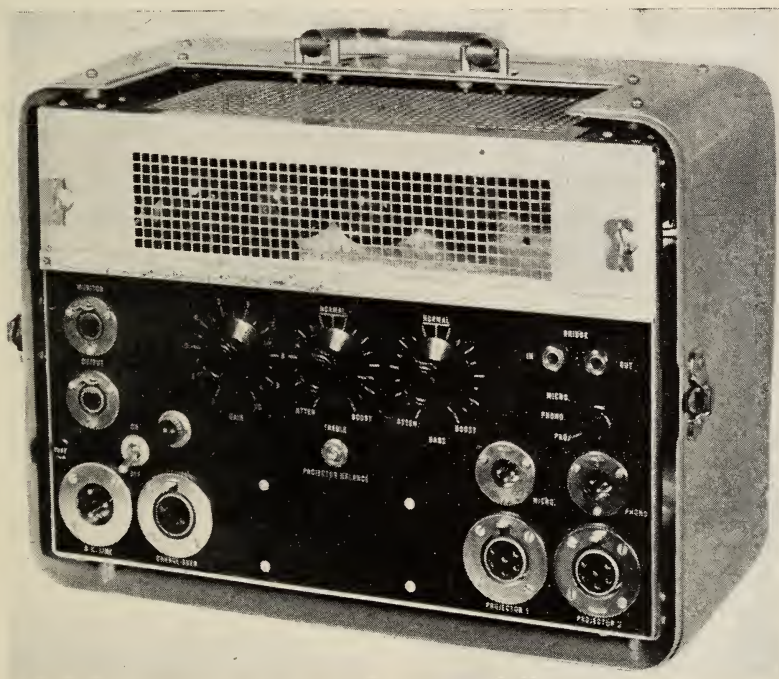
Projector, showing (1) a magnetic sound head fitted above first sprocket, (2) gravity rollers and (3) pre-set adjustment for manual loop setter.

down. Age and use cause the solvents in film stock to evaporate and this results in shrinkage. The loop-setter enables the loop to be reset manually without stopping projection ; this device is adjustable to compensate for a range of shrinkage up to 1.5 per cent, and preserves the correct relation of 26 frames separation between picture and sound scanning point.

### *Sound System*

The P.E.C. is of the PbS type which is more efficient than the commonly used

tem which is claimed to reduce all speed variations or flutter in the film at the scanning point from affecting the reproduction in excess of 0.25 per cent, which is, of course, inaudible. This system as will be seen consists of two gravity rollers resting on the film immediately before and after the scanning point ; these are so mounted as to allow free vertical movement. Since the mass of the rollers is small in comparison with the mass of the fly wheel, any speed irregularly results in displacement of the rollers, with no change in the flywheel speed.



*Fig. 6. Front view of amplifier.*

caesium type in that it affords marked freedom from hiss, and develops a signal of 0.2 volts directly from the film track across a 150,000 ohm load—an important factor in the reduction of the parasitical noise level to a value some 60 db. below full rated output of both projector and amplifier. Previously normal equipment has had a noise value of 30-40 db. below the power output of the amplifier alone.

Sound filtering is achieved by a new sys-

This "gravity" system comes to a fully balanced condition in less than three seconds. The noise level of the projector mechanism is less than 60 db.

As this equipment is fitted for dual-unit operation, a change-over device is incorporated. This is operated from a push-button mounted on the projector panel ; this energises a solenoid linked to a "dowser" blade concentric with the shutter, and simultaneously opens the exciter-lamp circuit.



The two projectors are bridged by cable harness and the changeover is instantaneous, the reverse action taking place in the incoming machine.

### Amplifier

The valve line-up of the amplifier consists of one 6SJ7 as a simple input voltage gain stage with an amplification factor of 80 (38 db); a 6SL7-GT in a tone control circuit; a 6SL7-GT as the phase inverter the second section being connected as a cathode follower, and two 6L6's in class AB push-pull as the power-output stage. A 6V6 is used in a Hartley oscillator circuit to supply the exciter lamp (6 v., 1 amp.) with 112 Kc. frequency. 12 db. negative feedback is applied to the cathode of the first section of the third valve above.

Power output is sufficient when used with conventional theatre speakers to accommodate 1,200 seats. The amplifier is further provided with input sockets enabling it to function as a Public Address System—e.g. emergency battle warning system on board naval units, etc.,—when its output can be raised to 35 watts distorted—a disc recorder, or as a magnetic tape recorder, using the supersonic oscillator frequency as bias.

There are three main controls, the Gain

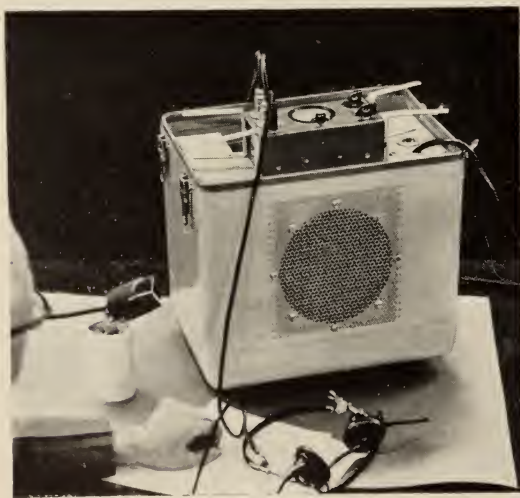


Fig. 7.

*Magnetic sound play-back. The control panel is mounted in the loud speaker case.*



Fig. 8.

*Recording a magnetic track to a 16mm. film with the projector fitted with magnetic sound head.*

control operating on the grid of the first 6SL7 while the separate Bass and Treble controls give boost by altering the degree of feedback through suitable networks across both triodes of the first 6SL7; attenuation is obtained by varying the frequency characteristic at the input. When turned clockwise from "Normal" the treble control gives H.F. boost above 700 c.p.s., and anti-clockwise an attenuation above this frequency. Similarly, the Bass control attenuates below 700 c.p.s., or provides a 4 db. boost at 100-200 c.p.s. The electrical noise level of the amplifier is less than 40 db. below full rated output.

In concluding this paper I should point out that standardisation of the printing and recording characteristics of the film to be used with this equipment is also being carried out in order to secure optimum performance.

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3. Non-theatrical Film Report, "Recommendations for Educational 16 mm. Projection." *J. Soc. Mot. Pic. Eng.*, 37, 22, July, 1941.



## THE DIMMING OF FLUORESCENT LAMPS AND THEIR USE IN THE KINEMA

J. W. Strange, Ph.D., A.R.C.Sc.\*

*Read to a Meeting of the Theatre Division on April 8, 1952*

**R**ECENT developments in the control of the fluorescent lamp, or to give it its full description, the low pressure mercury vapour discharge lamp with a fluorescent coating, have permitted a much wider application and a greater realization of its potentialities. The main basis of this lamp is the chain of processes consisting of conversion of electrical energy into ultra-violet radiation by the low pressure mercury discharge, the absorption of this radiation by the phosphors forming the coating of the lamp, and finally the re-emission of the absorbed energy as visible radiation. By choice of the phosphor used, it is possible, for the first time in any light source, to control the colour of the emitted light.

This has, of course, been realized in part from the very beginning of the use of these lamps. In consequence there was a limited decorative application. In the form of the cold cathode lamp where a limited range of brightness control was possible, further applications to display lighting were also possible but these were limited by the high voltage problems of that type of lamp.

Until recently it was commonly assumed that it was not possible to vary the brightness of the hot cathode fluorescent lamp except over a very limited range. New circuits have now been developed which achieve this, and many interesting applications have been made possible. Colour by itself is a very attractive element in any display or presentation, but changing colour has an irresistible fascination, so in addition to meeting the exacting technical requirements of stage lighting the fluorescent lamp with its new range of control has obvious applications to a wide range of display work as well as to the general lighting of auditoria and cinemas. The specialised applications to cinemas are not many but two

will be mentioned in some detail.

The main purpose of the paper is to draw attention to the characteristic features of the fluorescent lamp and to emphasize how its potentialities may be realised to the full. It has been considered for too long as a replacement for the incandescent lamp. In part this is true but in part it can never be this. It can never, for example, provide a concentrated source of light. As a new source with remarkable new features it has many applications.

### Recent Developments in the Fluorescent Lamp

Before passing on to the new developments in the circuits and their applications it is worth surveying briefly the upward trend in the quality of the lamp itself. By its very nature it is a more expensive article than the incandescent lamp and it requires in addition relatively expensive control gear and fittings. Its obvious advantages of increased efficiency were, in the early years of its manufacture, not overwhelming arguments in its favour because the replacement charges were still fairly high for the lamp life then obtainable. The detailed examination of the balance between the saving on running costs due to the increased efficiency, and the increase in initial and maintenance charges is a most complex one, and obviously varies widely according to the power cost, hours of use, etc.

Whatever the factors that have influenced judgment in the past it is true enough to say that the last two or three years have seen a marked upward trend in the quality of fluorescent lamps.

In contrast to some other products fluorescent lamps improve when made by large scale production methods. This holds not only for the actual pumping and sealing of lamps themselves but for each process from the

\* Thorn Electrical Industries, Ltd,

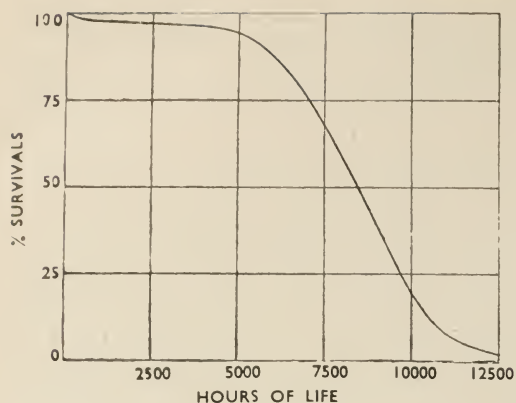


Fig. 1.

*Mortality curve for 4' -40 watt lamps made in 1949. Three hour switching cycle.*

manufacture of the phosphors through the coating and baking of the tubes to the final automatic testing of the finished lamp.

Efficiencies have risen, but possibly of even greater importance, the life of the lamp has improved. Some English makers are now guaranteeing an average life of 5,000 hours and American manufacturers are claiming an average life of 7,500 hours. The difficulty with all such figures is that it is a very slow business accumulating them. A guarantee of 5,000 hours means life testing a considerable number of lamps to well beyond that period and on the normal life test cycle of three hours on and half an hour off, 5,000 hours is not far short of a year's operation. A typical mortality curve for 4' -40W. lamps is given in Fig. 1. Such a curve shows the degree of reliability now achievable. Apart from a few early failures the lamps show a consistent pattern of behaviour which permits group replacement schemes to be operated with advantage. Coupled with this much longer life is a steadily increasing advance in efficiency.

The initial efficiencies of "White" lamps are now approaching 60 lumens per watt. The average efficiency through life is of course lower than that and to get a true picture we must take into account control gear losses, but even with these alterations the final figure is impressive compared with the 12-13 lumens per watt of the incandescent lamp. The ad-

vantage of the "White" colours is of the order of two or three hundred per cent but the ratio becomes far higher for colours such as pinks, blues and greens as will be seen in Fig. 2. Only in the red is the incandescent lamp anywhere near as efficient a source as a fluorescent lamp. The figures given compare fluorescent lamps with combinations of incandescent lamps and filters. Filters are used with the fluorescent lamp only in two cases, Red 6, and Blue 19. Further reference will be made to this question of efficiency of coloured lamps in a later section but the basic problems of control of the fluorescent lamp will first be considered.

### Dimming Circuits

As it has been stated in the introduction a limited range of dimming is possible with cold cathode lamps but this is quite inadequate for stage purposes unless a variable impedance is put in the secondary of the power transformer. This presents many difficulties at the high voltages used and it can hardly be looked upon as a practical method.

The dimming of hot cathode lamps was

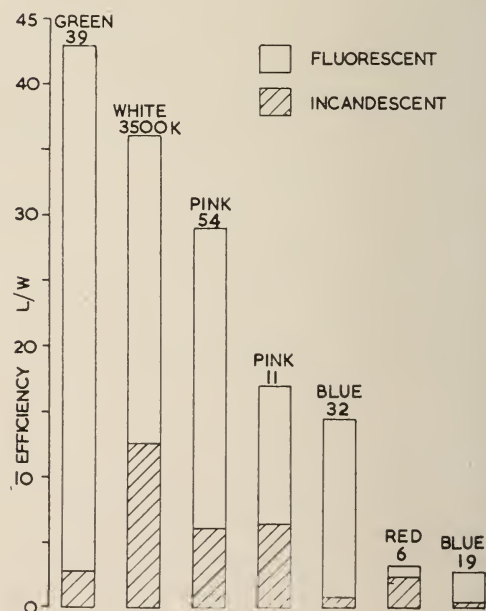


Fig. 2.

*Comparison of the efficiency of fluorescent with incandescent lamps.*

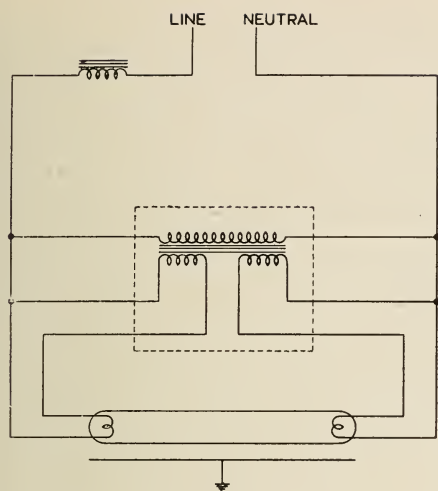


Fig. 3.  
Quickstart circuit.

long held to be impossible. Text books<sup>1</sup> on fluorescent lighting agree on this point. The basic solution of the problem is, however, in many ways a straightforward one. The main difficulties were met, not in getting one lamp and one circuit that would give a good range of control but to get 100 per cent reliable operation with all lamps on circuits which were not only reliable but also sufficiently cheap to offer advantages over corresponding incandescent circuits. The later point is partly a commercial one involving detailed costings of installations and outside the scope of this paper. Some information will be given in a later section.

The main technical description of the circuits was first published in 1949<sup>2</sup> and there is no need here to trace the full development of the circuits used. It will be sufficient to deal with the main features.

The hot cathode lamp depends for its stable operation upon two main things. At each end of the lamp are coiled filaments coated with a thermionic emissive coating. Prior to striking the lamp, these filaments or cathodes must be heated to a sufficient temperature to emit electrons. Under the influence of the applied field these electrons cause ionisation in the surrounding gas and if the potential difference between the two cathodes is sufficient, ionisation spreads throughout

the tube, the gas becomes conductive, and a discharge is set up. Arc discharges in gases have a negative resistance characteristic; as the current increases the resistance falls. The second essential element is, therefore, a ballasting impedance which limits the current at some optimum value. In general the stabilising effect of such a ballast is achieved if about half the supply voltage is dropped across it:

If now, by some means such as reducing the supply voltage, the lamp current is reduced in order to dim the lamp, a number of factors come into play all tending to produce unstable operation. Due to the lowering of the current the cathodes which are normally kept at a sufficiently high temperature for thermionic emission by the passage of the lamp current, may fall below that point and the voltage necessary to draw electrons out will be increased. The lower current will also mean a lower voltage drop across the ballast and it will become less effective. In addition the available voltage to initiate the discharge will also be reduced. It will be apparent that there are three main requirements for satisfactory and stable operation of a "dimmed" lamp:

- (1) Adequate cathode heating irrespective of lamp current.
- (2) A sufficient series impedance to produce stability, also independently of the current.

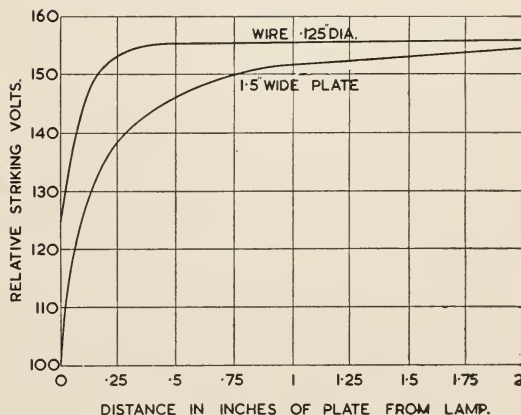


Fig. 4.

Relationship between striking voltage and size of adjacent earthed plate.



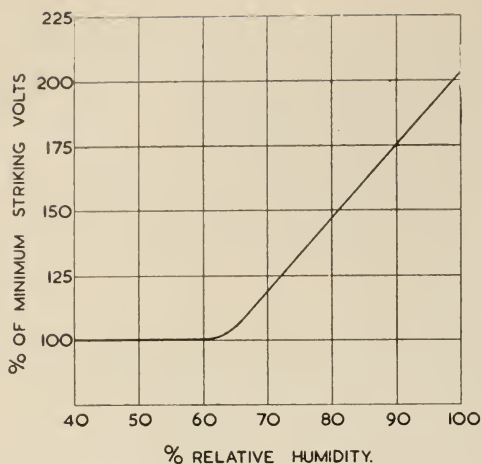


Fig. 5.

*Relationship between striking voltage and humidity.*

- (3) Sufficient voltage to initiate the discharge at any required level of brightness or lamp current.

The first indication of a successful way of dealing with this problem lay in the Quickstart circuit; this is shown in Fig. 3 and consists of a filament transformer with the primary connected across the lamp and the secondary windings in series with the filaments. On switching on the supply nearly the full voltage is across the primary winding and the cathodes are rapidly heated and as soon as they reach emission temperature the discharge should strike. The note of caution is sounded because before this circuit gave completely reliable operation, certain requirements had to be met and these apply, not only to the Quickstart circuit, but to dimming circuits. With the Quickstart circuit no voltage surges are produced as in starter switch circuits and without such assistance the initiation of the lamp discharge presents difficulties. These can be overcome by providing closely adjacent to the lamp an earthed metal strip. This causes a small capacitive current to pass thereby encouraging ionisation to spread and the voltage necessary to "strike" the lamp is considerably reduced as will be seen in Fig. 4. The effect can, however, be largely destroyed under conditions of high humidity by the appearance on

the surface of the lamp of a layer of moisture and the striking volts may rise sharply (Fig. 5). This effect can be successfully counteracted by either a metal strip along the glass surface or alternatively, a humidity repellent coating which breaks up the water film and keeps the resistance high. This Quickstart circuit, after the necessary precautions have been taken, gave excellent reliability and over a wide range of supply voltage. At low voltages cathode heating still becomes inadequate because the voltage across the primary of the Quickstart transformer is of course reduced when the lamp is running, and even with the heat provided from this source added to that supplied by the lamp current itself the temperature of the cathodes is too low and the lamp ceases to operate. By careful design and by taking the primary of the transformer direct to the supply, as is indicated in Fig. 6, this problem was successfully solved without running into the danger of overheating the cathodes in the full-up condition.

The other problems of instability and striking volts were met by abandoning variable voltage control and providing a separate variable impedance for each lamp circuit. As the lamp current is reduced and the stabilizing potential fall across the ballast is

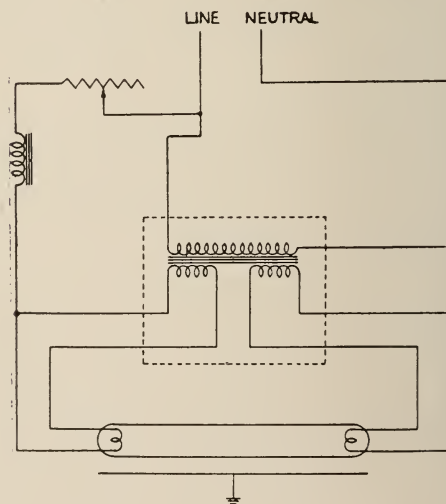


Fig. 6.

*Dimming circuit.*

reduced, the dimmer impedance itself provides the stabilizing feature of the circuit. The separate impedance has the other major advantage that the full circuit voltage is across the lamp prior to the initiation of the discharge, whatever the position of the dimmer control. The dimmer impedance may take a number of forms, including a simple resistor or a saturable reactor. On the face of it, the provision of separate resistors for each lamp circuit may seem prohibitively expensive, but in practice the majority of the components of the step type resistors are of the 1W. or 2W. radio type and the costs of the control boards are only a little in excess of the corresponding incandescent boards. Saturable reactors, on the other hand, if they are to give a wide range of control must be large and expensive. The problem with the fluorescent lamp is a different one from that of controlling an incandescent one. In the latter, the current only falls to about half of the full-up value at blackout, so the impedance required is limited. With the fluorescent lamp, on the other hand, there is roughly linear relationship between light output and current so the impedance range required is very large.

The first objective that was set was a range of 400 to 1. With separate resistors this is a straightforward matter but with saturable reactors the cost rises steeply as the range is increased.

Since the first developments of this circuit a number of modifications have been tried out. The chief variation of the basic circuit which has found practical application is what has been described as a cascade circuit. In this two or more lamp circuits are run off a common dimmer by means of a series of matching transformers (Fig. 7). The primaries of these transformers are connected in series with the dimmer impedance and the supply, while the secondaries feed the separate lamp circuits. In the normal arrangement of supplying a number of lamp circuits from a common supply and resistance, the first lamp that strikes reduces the potential available for the other lamps. In the cascade circuit the reverse is true, when one lamp strikes the impedance of its corresponding transformer is reduced

and the potential drop across the others is increased. This arrangement is more expensive in actual control gear costs because of the extra transformer but it has considerable advantages in wiring costs, particularly in cases where building limitations come in, or where existing wiring must be used.

### The Relationship between Cost and Design

Before passing on to describe the applications of the circuits, it may be interesting to compare the costs of some different installations. Even the most interesting and elegant solution of a technical problem may remain as an encumbrance to the patent files, or as an illustration in some handbook of the sub-

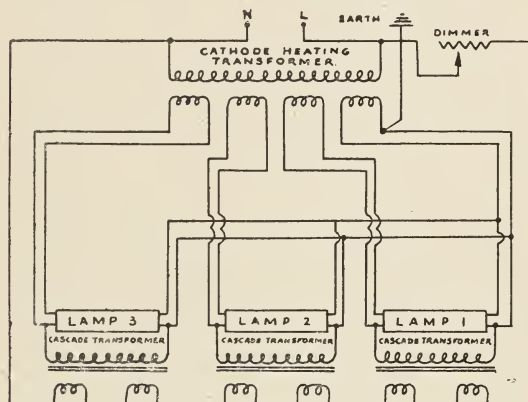


Fig. 7.

*A cascade circuit.*

ject if, in fact, it does not offer either an appreciable saving in cost in installation or running, or some marked advantage in use.

The considerable demands made particularly by stage producers, was the first difficulty to be met in the effort to keep the cost down. Completely smooth dimming from full-up to black-out was demanded, and quite rightly the first objective was to see how far this most difficult requirement could be met. Examination of standard dimmers showed that, in fact, some compromise with this optimum condition was generally accepted. For example, dimmers with 100 steps were most commonly used. If the change of brightness in moving from step to step was restricted to about 6 per cent the overall

range of brightness was limited to 400 to 1. By increasing the size of each step a wider range could be achieved, but there was always the danger that noticeable flicker would then occur with movement of the dimmer. The minimum perceptible change, or the "Fechner fraction," when it is measured under the most critical conditions of viewing and at fairly high levels of illumination, is about 2 per cent. In practice such conditions are not met and the light on a scene is derived from a number of sources. The use of 100 steps of about 6 per cent each was quite acceptable.

Using such dimmers the next problem was the size of lamp that should be used. It had to be a high loading type of lamp in order to get as much light per foot run as possible. The choice lay between the 2ft. 40W. lamp run in pairs, and the 5ft. 80W. lamp. The advantage of the 40W. lamps was that with their shorter length it was easier to initiate and maintain the discharge at low currents, and the first decision was to use these lamps. Further experience and improvement in the manufacture of the 80W. lamp showed that these lamps could meet all normal requirements and a further decision was taken to transfer to these lamps with considerable saving in cost and increase in efficiency. This was a case where in the interest of optimum technical performance we took a decision which had later to be reconsidered.

The fittings used play an important part and during the application of these circuits important economies were achieved.

At first sight the provision of the separate wiring to each lamp would appear to be a major item of expense. However, the low currents used and the development of very compact multiple cables has cut this cost and this now only appears as a reasonable low figure of the normal installation. Only in two cases is it a major item of expense. The first is in auditorium lighting where exceptionally long cable runs may be required. As stated in the preceding section this can be avoided by the cascade circuit and in such cases the additional cost of the matching

transformers is amply repaid. The second case where difficulty arises is when it is essential to use existing wiring and, in this case also, the cascade circuit provides the answer.

One other major item of expense which normally occurs in stage lighting is the provision of coloured filters which must be used for colour effects with incandescent installations. In one large theatre the expenditure on this item alone was reported to be £400 per annum. A three colour system of mixing may be used but it is relatively inefficient and it is quite common to change filters to meet the requirements of the individual producer. Filters are, in addition, fragile and particularly in front of the hot filament lamp have a short life. Blue filters, in particular, bleach very easily and a crack in such a filter may have a disastrous effect on a lighting scheme.

The advantages that appear from a comparison of fluorescent and incandescent installations on grounds of efficiency are very considerable as has already been referred to in the first section and illustrated in Fig. 2. The ratio of efficiency varies between a limited increase of about 40 per cent in the red to a ratio of 27 to 1 in the blue. One other point needs to be referred to before we look at the system as a whole. In any stage production a fair proportion of the lamps are "on check" for some part of the time. An incandescent lamp still consumes half the normal wattage when its light output is reduced to blackout. In the fluorescent lamp on the other hand, the watts consumed are closely proportional to the light output, with the exception of the control gear losses. This point is made clear in Fig. 8, and it will be seen that the ratio of efficiency given here for a "White" lamp goes up by a further factor of 3 to 1 as the lamps are dimmed.

To summarize these various factors in one single cost comparison is an almost impossible task. There is certainly some increase in the initial cost of a fluorescent installation. The figure of 25 per cent has been given but it will obviously vary from installation to installation. The savings are even more problematical, but in one theatre it is a matter of



record that the expenditure on power over a period of a year went down to one third, and the additional cost of the equipment was paid for in three years.

## Applications

### Stage Lighting

Since their first use during 1949 the methods of control described have found wide and very varied application. The most interesting applications have been in many ways to the problems of stage lighting because the requirements are the most stringent. The commercial kinema with its stage shows as part of the programme comes within this group but for

In order to indicate the position it has won in less than three years it is sufficient to report that eight theatres have been equipped, ranging in size from the Watergate, London, to the Garrick, Southport. Portable equipment has also been used by producers such as Sir Laurence Olivier in "*Venus Observed*," "*Damascus Blade*," and "*Captain Cavallo*," and by Robert Nesbit in "*Latin Quarter*."

### Auditorium and Kinema Lighting

The possible field of application to auditorium lighting, and the kinema should be included, is very large. The long diffuse source, the cool running lamp, the choice of colour, and now the control of brightness, are points which recommend the fluorescent lamp for the lighting of arches, coves, and curtains and the other requirements of the architect. The Prize at Gretna was described recently,<sup>3</sup> and the Ambassadors at Pendleton is another example.

### Exterior Use

Sodium and high pressure mercury lamps have a well established place in the lighting of buildings but for natural scenes including foliage their colour distribution gives a very harsh result. Fluorescent lamps on the other hand produce lovely effects. There is a wide range of colours and the broad emission bands of the phosphors give good colour rendering. The Pleasure Gardens at Battersea and the Jephson Gardens at Leamington Spa are two sites where they have been used and have been seen by many.

A further development has been the use of units for under-water lighting. A beautiful example of this was the lighting of the Steine Fountain at Brighton. 24 three colour units were used mounted in the different basins. Installed originally for the British Electrical Power Convention in July, 1951, it was retained by the Corporation as a permanent feature.

### Special Kinema Applications

#### Ultra-violet Sources

A field that has so far been little explored is that of low pressure ultra-violet sources.

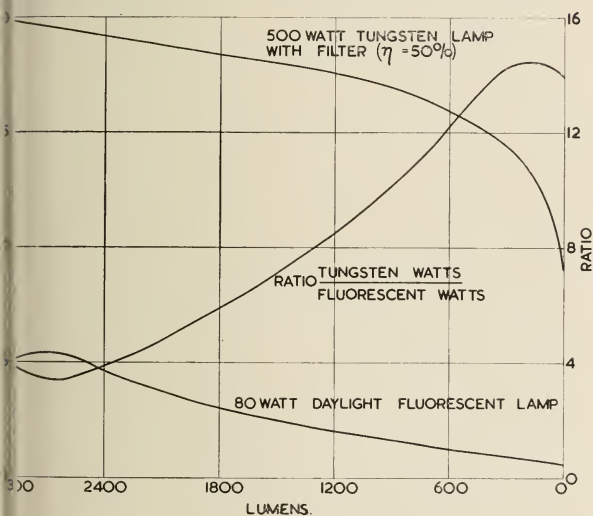


Fig. 8.

Comparison of efficiency of lamps during dimming.

most purposes the kinema is only a particular case of auditorium lighting.

In the early days, fluorescent lighting was condemned out-of-hand for a variety of reasons. A number were directly due to misunderstanding of the nature of the fluorescent lamp. It was never claimed to be, and never will in fact be, a substitute for the concentrated directional lighting provided by incandescent units. Used with intelligence and understanding it has undoubtedly made a place for itself in stage lighting and particularly to cyclorama and backcloth lighting. For variety work where many changes of scene occur it is also popular.

As well as converting the short wave ultra-violet light of the mercury discharge into visible light, we can with equal facility convert it into the long wave ultra-violet about 3600 A.U. Such lamps can, as easily as the others, be controlled in brightness which is an obvious advantage over the high pressure type of which the brightness cannot be controlled, and which needs a long period of warming up to reach full brightness. To exclude the visible light entirely necessitates the use of a black glass filter which is an expensive addition. There are probably a number of applications with or without filters and one with a particularly kinematograph application is the combination with carpets treated with a fluorescent material for gangway lighting.

### *Surround Brightness Control*

Most of the applications of the fluorescent lamp which have been dealt with have been common to the lighting of auditoria and theatres as well as to kinemas. One of the few applications which is peculiar to the kinema is the control of screen surround brightness. The general problem has excited widespread interest and at the recent International Conference on Illumination in Stockholm, in June 1951, it was recommended that each country represented should seek to collect information on this subject as well as on screen brightness values. The subject was recently reviewed by Pulman<sup>4</sup> who pointed out that with the improved equipment now available it is possible to exceed the top limits of screen brightness laid down in B.S. 1404. He also noted that flicker perception can rise well above the commonly quoted figure of 32 c.p.s. at high brightness levels. The fluorescent lamp amply confirms this statement because although most of the light output from the lamp has a frequency of 100 c.p.s. on a 50 c.p.s. supply, a narrow region in front of the cathodes has a frequency of only 50 c.p.s. A proportion of people can readily perceive this and unless it is avoided by screening, or reduced by the use of long lag phosphors or careful coating control, it may be a source of discomfort. It is certain there-

fore that the normal frequency of 48 c.p.s. used in projection gives no assurance that flicker will be ruled out. Glare resulting from the high contrast between the picture and the surround is the main problem, but it seems probable that by reducing contrast discomfort, flicker discomfort can also be eased. The early history of kinematograph projection, with low brightness as the main problem to be met, has led to the use of black masking as one way of improving the apparent brightness. Modern work by Hopkinson, Mackenzie and Nixon,<sup>5</sup> by Guth,<sup>6</sup> and by Logan<sup>7</sup> has shown that the brightness of the surround has a very important influence in controlling the amount of discomfort glare. Like all matters involving subjective judgment, it is difficult to get a clear cut answer. Great skill is needed in handling the people making the judgments, and in asking them the right questions. The latter work of Hopkinson<sup>8</sup> demonstrates the problems involved. With some caution therefore it is worth recalling that experiments<sup>5</sup> showed that the average luminance of the screen, the immediate surround to the screen and the general surroundings, should be in the ratio of 100 : 10 : 1. There was also another important conclusion that the angular subtense of the screen surround should not be less than three times the subtense of the screen itself, if the surround was to have its proper influence.

After that digression, it may be said that this presents a difficult problem for the kinema engineer because he is limited by physical dimensions in every direction. In particular, the depth behind the screen may be restricted and he has in any case to avoid spillage of light from the surround on the projected picture itself. It is also desirable in order to avoid distraction, to have the surround uniformly lit, to be able to control the light and, if necessary, the colour. A long linear source such as the fluorescent lamp coupled with the control of brightness and colour now available obviously lends itself to this application. By choice of a suitable reflector, the main light beam can be concen-

trated within 40° or less and an even illumination of the surround can be achieved with very little available depth. Automatic dim-

ming is now available so the linking of surround brightness with average screen brightness presents no great difficulty.

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### NEW FRENCH STANDARDS

**CINEMATOGRAPHY.** Specification and methods of test for sound recording equipment. (NF) S28-001, Aug. 1951).

The specifications include a section containing a number of general items of a mechanical or purely electrical nature, together with tests for susceptibility to magnetic fields and microphonic pick up.

Amplifier tests comprise input and output impedance, gain at 1 kc., frequency response over the range 30-10,000 c.p.s., harmonic distortion, and noise level.

The optical modulator system is tested for frequency response at modulation depths of 25 per cent, 50 per cent, 75 per cent and 100 per cent, using a calibrated P.E.C. monitor.

Two alternative methods of flutter test are described for the camera mechanism ; a frequency of 3 kc. being used.

Overall frequency response is measured at modulation depths of 20 per cent, 40 per cent and 80 per cent by recording test negatives and measuring same by microdensitometer.

Photographic tests also cover noise reduction adjustment, volume range (signal/noise ratio), cross modulation, intermodulation and harmonic content.

In presenting the test results, it is emphasised that adequate verbal description and diagrams be given, both of test procedure and findings. Response curves should be drawn using logarithmic scale of

frequency for abscissal and decibel response of ordinates. An ordinate scale of 1 cm. to 5 db. is recommended for facilitating comparison of results, but curiously, no dimension is mentioned for the logarithmic frequency scale length ! It would seem that a fixed ordinate/abscissal ratio would be more helpful in comparing results.

N.L.

### PHOTOMETRIC CALIBRATION OF CAMERA LENSES. (NF)S28-002, Aug., 1951)

The specification includes a description of the test apparatus, the method of use and recommendations as to calibration markings. An internally illuminated integrating sphere is used as a source, and the light transmitted through the lens under test illuminates an opal glass plate at the focal plane. The opal glass is fitted with a mask having a circular aperture of 2.5 mm. diameter, and the illumination of the glass is compared with that obtained when the lens is replaced by a standard mask of aperture f4.

A tolerance of 7 per cent is allowed in the scaling, which is always to be read after adjusting the aperture ring to its settings in a closing direction. Photometric calibrations are distinguished by the letter *T*, and where the lens mount carries both geometric and photometric scales, the latter should be marked in red.

N.L.



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**BOOK REVIEWS**

*Books reviewed may be seen in the Society's Library*

**THE ENTERTAINMENT FILM FOR JUVENILE AUDIENCES.** *Henri Storck. U.N.E.S.C.O. Publication. H.M.S.O.*

This is one of a series of studies published by U.N.E.S.C.O. on Press, Film and Radio in the

world to-day. Although British readers will find it in some respects disappointing, it represents the results of some painstaking though restricted enquiries by its author, carried out, one feels, in something of a hurry; for its rather discursive material has not been

well digested. The views expressed are those of the author and do not necessarily imply U.N.E.S.C.O. approval or support. The book disappoints because the methods of enquiry employed resulted in a lack of balance and there is, in consequence, a lack of universality. One looks to U.N.E.S.C.O. for carefully compiled reports on a world basis and for an independence of judgment and computation of individual national effort. In this case, these qualities are lacking and although the report quotes extensively from the writings and speeches of our Miss Mary Field, the outstanding efforts of Gt. Britain in the making of children's films are neither properly focused nor given their due place in the world pattern. As is not unusual in this kind of work, there is an altogether undue concern about the influence of the cinema on children from the moral standpoint and prolific quotations from alleged experts on child behaviour and psychology. In this arena of dispute and conjecture, the primary purpose of films for children, namely to entertain, seems to take a secondary place.

None the less, there is valuable material here about children's preferences, about types of films and about the technical problems of production. Nobody knows better than we in this country that the economics and finance of special production for children are precarious. Mr. Storck reminds us of the re-issue value of films every few years as the child audiences change. He suggests long term credits for producers and refers to the need for abolishing all obstacles to the free circulation of films, international payments, customs and censorship. He suggests that Governments might pay back to producers the entertainment tax levied on special children's performances. He does not seem to have been aware of the striking co-operative effort being made here by the film industry in setting up Children's Film Foundation Ltd., with financial support from the Eady Fund.

The section on distribution is, moreover, rather weak, which is a pity because future success in this

field depends largely on building up the world market. In fact, this book is the best possible recommendation for a really authoritative and universal study of the problem of films for children, directed not so much to questions of psycho-analysis, morals, censorship or child delinquency, but to the plain issue of how best to provide good, wholesome film entertainment for children throughout the world.

F. A. HOARE.

**THE ART OF TELEVISION.** *Jan Bussell, Faber & Faber, Ltd., 160 pages, 8 plates. 18s.*

Many books have arrived in this country from America dealing with the subject of television programmes and production, and now here is one from a British producer describing the British way of television.

Although it is not intended for technical readers the information given is so complete and well presented that it may well serve as an introductory textbook for those entering television on the artistic side.

The production of plays occupies the greater part of the text, and this is described stage by stage from the preliminary planning to the final rehearsal. Other aspects of television—variety, ballet, interviews, and commentaries are all given adequate mention. The chapter on "Writing for Television" gives some useful hints based on the author's own experience, and a sample of a complete script of one of his plays is given as an appendix.

After reading the book one is left with a strong feeling of admiration for the producer who can steer a three-act play through all the intricacies of camera movements, cuts, and fades, with the knowledge hanging over him all the time that there are no retakes! This is a well-written book and worth reading by every engineer interested in something more than scanning circuits.

G. PARR.

## INTERNATIONAL CONGRESS — "CINEMA & TELEVISION"

The Third Convention of Cinema Technique : "CINEMA AND TELEVISION" will take place in Turin, Italy, from the 6th to 9th October, 1952.

The Convention will take place at the same time as the International Technical Exhibition, and the proceedings will be devoted to the relations between the cinema and television.

The following subjects will be considered :

- (a) Television projection on large screens.
- (b) Film recording of television transmissions—The electronic film.

(c) The problems of film production in relation to television.

(d) The running of cinema-theatres and large screen television.

(e) The use of standard films in television transmissions.

It is intended to promote discussion and the exchange of information on the foregoing subjects, and to this end you are invited to submit papers, which should be sent to the Organising Committee of the Congress at 20 Via Massena, Turin, at the earliest possible date.



## THE COUNCIL

*Summary of the meeting held on Wednesday, May 7, 1952, at 164, Shaftesbury Avenue, W.C. 2*

**Present :** Mr. L. Knopp (*President*) in the Chair, and Messrs. B. Honri (*Vice-President*), R. E. Pulman (*Hon. Treasurer*), G. J. Craig, F. S. Hawkins, H. S. Hind, N. Leever, S. A. Stevens and D. Ward.

**In Attendance :** Miss J. Poynton (*Secretary*).

*Apologies for Absence.*—Apologies for absence were received from the Hon. Secretary, the Past President and Messrs. T. W. Howard and T. M. C. Lance.

*Deputy Vice-President.*—Mr. H. S. Hind is appointed Deputy Vice-President.

*New Patron Member.*—Messrs. Cinit, Ltd., has become a Patron Member of the Society.

*Royal Photographic Society.*—Mr. G. J. Craig, Chairman of the Library Committee, is appointed the Society's representative to serve on the Royal Photographic Society's Library Committee.

*Television Division.*—The activities of the Tele-Kine Group are now concluded and a Television Division has been inaugurated. In addition to the representatives from the other Divisions the Council has made the following appointments to the Television Division Committee :

Messrs. T. M. C. Lance (*Chairman*)  
G. E. Burgess  
W. Cheevers  
M. Cooper  
L. C. Jesty  
R. E. Pulman.

### COMMITTEE REPORTS

*Membership Committee.*—The following are elected :

Richard David Hardy (Associate), Carlton Cinema, Leeds 2.

Stephen Samuel Varney (Member), Gaumont State, Kilburn, N.W.6.

Alfred George Ernest Dell (Associate), Tatler Cinema, Foregate Street, Chester.

Norwood Lee Simmons (Associate), Eastman Kodak Co. 6706, Santa Monica Blvd., Hollywood, California, U.S.A.

Walter Alfred Cantrell (Associate), Futurist Cinema, Lime Street, Liverpool.

Alfred John Slade (Associate), King's Picture House, London Road, Liverpool.

Thomas Whoston (Associate), Odeon Theatre, Cleveleys, Lancashire.

Vijayaraghavachariar Ramaswamy (Associate), Gemim Studios, Madras 6, India.

The following is transferred from Associateship to Membership :

Raymond Cecil Lange Thorn, Pathéscope, Ltd., North Circular Road, N.W.2.

*Report received and adopted.*

*Apprenticeship Scheme Committee.*—A Sub-Committee constituted of representatives of the Society, the N.A.T.K.E. and the C.E.A. is appointed by the above Committee to re-draft the syllabus in the light of recent discussion with representatives of the Association of Principals of Technical Institutions and the Association of Technical Institutions.

*Report received and adopted.*

*Library Committee.*—A new library catalogue will shortly be published.

*Report received and adopted.*

*16mm. Film Division :* The conclusion that is drawn from Clause 2A of the Cinematograph Bill, that regulations may be drafted without consultation with the industry, in causing some anxiety. Endeavour will be made to secure full representation on the Committee which will deal with the matter.

*Report received and adopted.*

The proceedings then terminated.

### H.M. THE QUEEN'S BIRTHDAY HONOURS

While the President, Dr. Leslie Knopp, is in America at the I.S.O. Conference, the good news is received that he is appointed Member of the Most Excellent Order of the British Empire.

Members are urged to keep their fellow members informed of their activities through the medium of *British Kinematography*.

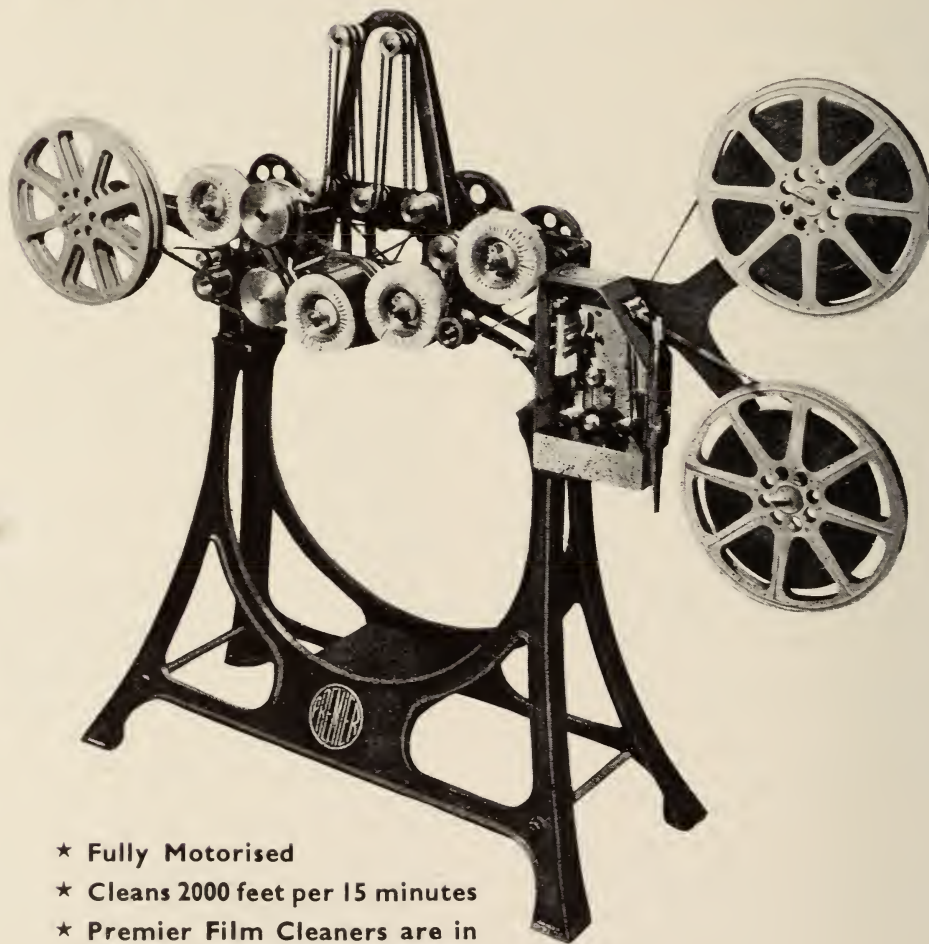
### OBITUARY

It is with deepest sorrow that the passing of Frank Roy Duke is announced. He has been a member of the Society since 1942 and at the time of his death was the Southern Counties Service Engineer for Charles H. Champion & Co. Ltd. He died suddenly at his home in Eastbourne on May 17.

"Dukie," as he was popularly known, had been with Champion's since 1931, and his passing will be a great loss to his firm as well as to his many friends. He was hailed as a good fellow and respected by all who had the pleasure of knowing him.



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# **BRITISH KINEMATOGRAPHY**

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THE BRITISH KINEMATOGRAPH SOCIETY  
164 SHAFTESBURY AVENUE, W.C.2.



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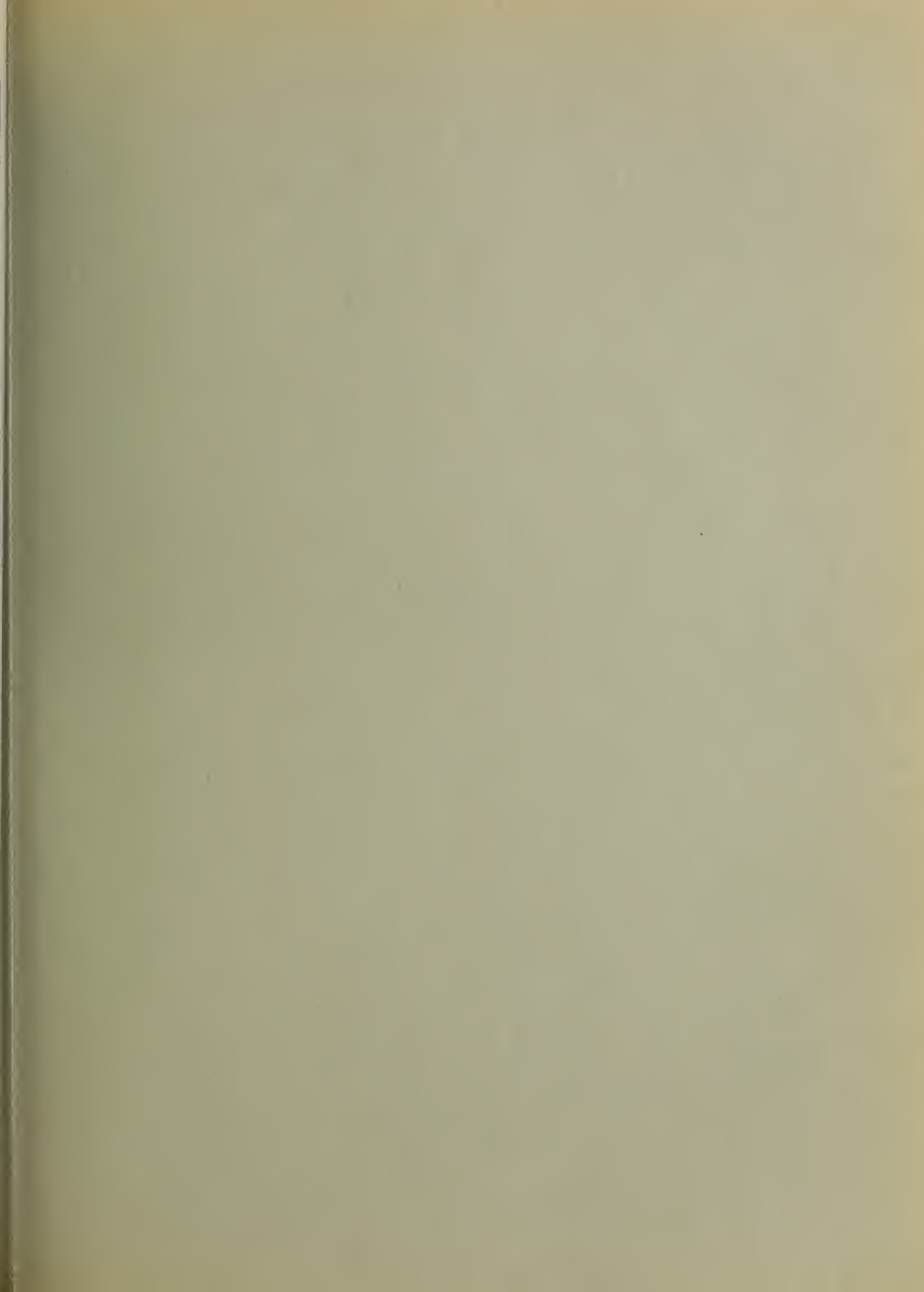
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# BRITISH KINEMATOGRAPHY

VOLUME 21 No. 1

JULY, 1952

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## BRITISH STANDARDS INSTITUTION

MEMBERS may not be aware that the British Standards Institution was initiated in 1901 as the Engineering Standards Committee, changing its name in 1918 to the British Engineering Standards Association. In 1929 a Royal Charter was granted and the scope of the Association's work was widened to embrace the chemical and building industries in addition to the engineering industry. To give expression to this extended scope, the name of the organisation was changed to the "British Standards Institution" in 1931.

At the present time there are nearly 2,300 committees operating under the aegis of four Divisional Councils, the latter covering the fields of engineering, chemistry, building and textiles, respectively. Last year 3,337 committee meetings were held and the number of committee members is nearly 14,000.

Under each Divisional Council there are a number of Industry Standards Committees, and under the Engineering Divisional Council is the Kinematograph Industry Standards Committee, which was appointed in 1936, "To direct the work of the Institution regarding the preparation of standards in the field of cinematography." The British Kinematograph

Society from the beginning has played a prominent part in the formation of committees concerned with motion picture standards.

The Cinematograph Industry Standards Committee operates through a number of Technical Committees carrying out the work concerned with motion picture films, cinematograph release prints, cinematograph electrical equipment, projection room equipment, inflammability of films, exciter lamps, screen luminance, 16mm. sound and picture projectors, 35mm. sound and picture projectors, lenses for 35mm. kine-projectors, standard forms for cinematography, lenses for sub-standard kine-projectors, cinematograph film processing and processing equipment.

Each Technical Committee has a number of Sub-Committees and in all there are approximately 40 Committees concerned with the drafting of standards relating to cinematography.

At the moment of writing, the President of The British Kinematograph Society is representing the British Standards Institution at an International Standards Organisation meeting in New York on the matter of International Motion Picture Standards.

I. D. WRATTEN.

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## THE THIRD ANNUAL CONVENTION

*The third Convention of the British Kinematograph Society took place at the Gaumont-British Theatre, Film House, Wardour Street, London, W.1, on Saturday, May 3rd, 1952. As well as a programme of special films, which was shown during the afternoon, the Annual General Meetings of the three Divisions took place, and were followed by the Sixth Ordinary Meeting of the Society.*

### Annual General Meetings

THE proceedings commenced with the Annual General Meeting of the 16mm.

Film Division, under the Chairmanship of Dr. D. Ward. Apart from the usual activities, the Division's main achievement was the work of the Investigation Committee, conducted under the Chairmanship of Mr. Norman Leever. The report, when published, would be an important step forward in the history of 16mm. film.

An *Ad Hoc* Committee, under the Chairmanship of Mr. C. B. Watkinson, had been examining the opportunities which exist for keeping abreast with the technicalities of 16mm. film production, and the programme of meetings for next session was likely to afford the opportunity to study films of outstanding technical merit.

Mr. W. Buckstone, the first Chairman of the Divisional Committee, had retired from active participation in committee work. He had made a valuable contribution to the Division and to the Society and would be greatly missed.

The Annual General Meeting of the Film Production Division followed, with Mr. Baynham Honri in the Chair.

The papers chosen under the series title "Long Term Developments in the Industry," dealing with magnetic recording, the electronic camera and high-definition films and colour processes, had proved both interesting and thought-provoking. The course of study at Ealing Studios of "Kine Camera Technique" was one of the outstanding successes of the year and was supported predominantly by members of the Film Production Division.

The first section of the programme concluded with the Annual General Meeting of the Theatre Division, under the Chairmanship of Mr. S. A. Stevens.

Time had been taken by the forelock in carrying out early in 1951 the preliminary

work of drafting a syllabus for the training of projectionists. The task of the Projectionist's Apprenticeship Scheme Committee had been lightened considerably by the Division's wisdom in anticipating the requirements of the future.

The number of chief projectionists who had applied for full membership of the Society had fully justified the provision made by the Council for chief projectionist engineers to qualify for this grade. The course of study on "Television in the Kinema" was well supported by projectionists and it was hoped to meet the demand for repeat courses in the provinces during the coming year.

An item of particular interest on the agenda was the report of the position in Leeds and Manchester. A brief outline of the activities in these two cities was sufficient to show the advance which had been made in recent times towards building virile branches of the Society, and to emphasise the energy with which the Hon. Secretaries, Mr. N. J. Addison and Mr. A. Wigley, had carried out their task.

### Ordinary Meeting of the Society

The last item before tea was the Sixth Ordinary Meeting of the Society, when the President, Dr. Leslie Knopp, took the Chair.

In giving a broad survey of the year's activities, the Hon. Secretary, Mr. R. J. T. Brown, pronounced the past year as being one of the most successful in the history of the Society. High priority in importance was given to the courses of study which had been arranged; no less than 404 students had enrolled during the year. Under the Chairmanship of Dr. F. S. Hawkins, the Education Committee had arranged two courses. The first was on Kine Camera Technique at Ealing Studios and the second was on Sensitometry at the Colonial Film Unit.

It was recalled that the Tele-Kine Group of the Television Society and the British-Kinematograph Society was formed in May, 1951, for a preliminary period, to promote the study and discussion of the joint application of cinematography and television technology. A course of study on "Television in the Kinema" met with great success and a further course on the same subject was arranged to meet the demand. Altogether, 275 students attended the courses. This successful experiment, and a growing demand from the members, had resulted in the inauguration of a Television Division of the Society. It would be administered similarly to the other Divisions, and enrolment would be open to all members occupied, or with an interest, in any branch of television technology.

An important milestone in the history of the Society was its nomination as a certifying authority, together with the C.E.A., and the N.A.T.K.E., for the Projectionist's Apprenticeship Scheme. The step indicated recognition of the technical stature of the Society and its competence to deal with matters of this nature.

It was recorded that the number of new members enrolled in the past year was about the same as for 1950/51. The totals on the register were as follows :

Hon. Fellows, Fellows and Hon.				
Members	...	...	...	50
Corporate members	...	...	...	592
Associate members	...	...	...	335
Students	...	...	...	34
Total				1,011

The recently concluded programme of papers had been well received. It was regretted, however, that it was not possible always to publish these since some were not intelligible without an accompanying demonstration. A shortage of subject matter for BRITISH KINEMATOGRAPHY sometimes resulted, but it was interesting to note that the number of papers submitted for publication only had progressively increased.

The Hon. Treasurer, Mr. Norman Leever,

presented the annual accounts with confidence. By rigorous control of financial matters, previous deficits had been converted into a surplus. The financial management of the Society consisted largely of balancing the services it was desired to give to members with those which it could afford to give. The present satisfactory financial position provided a sound basis for expanding the activities.

### Elections

Mr. A. Challinor, the Chief Scrutineer, announced that the following members had been elected to the Film Production Division Committee :

Messrs. G. H. Burgess  
T. S. Lyndon-Haynes  
J. P. H. Walton

Mr. T. W. Howard was elected, unopposed, the Divisional representative on the Council.

The following had been elected, unopposed, to the Theatre Division Committee :

Messrs. W. V. DeWan  
A. G. Duerdoth  
H. Lambert

Mr. S. A. Stevens was elected, unopposed, the Divisional representative on the Council.

The following had been elected, unopposed, to the 16 mm. Film Division Committee :

Messrs. M. Raymond, Jun.  
C. B. Watkinson

Dr. D. Ward was elected the Divisional representative on the Council.

The Society's officers, who had been returned, unopposed, were :

*President* : Dr. Leslie Knopp  
*Vice-President* : Mr. Baynham Honri  
*Hon. Secretary* : Mr. R. J. T. Brown  
*Hon. Treasurer* : Mr. R. E. Pulman

The three members elected to the Council, unopposed, were :

Messrs. G. J. Craig  
H. S. Hind  
T. M. C. Lance

### The President

In thanking the officers for carrying on the work during his illness, the President referred particularly to the activities of the Hon. Secretary, Mr. R. J. T. Brown and Mr.



Norman Leever. Mr. Leever had, through pressure of work, resigned his office of Hon. Treasurer and the Chairmanship of the 16mm. Film Division. The most valuable assistance had been rendered the Society by both these gentlemen.

The President's thanks were addressed also to the G.B. Picture Corporation and Mr. J. S. Abbott and his staff, the Management of Ealing Studios, Ltd., and Mr. Baynham Honri, the Colonial Film Unit and Mr. H. Davidson, the Electric Lamp Manufacturers' Association and Mr. E. B. Sawyer, the Patron Members, Journal Advertisers and the Trade Press.

A Vote of Thanks was moved by Mr. G. J. Craig to the President, members of the Council and members of committees, and a further vote of thanks was moved by Dr. F. S. Hawkins to the Society's staff.

After tea, the large theatre became the scene of activity, when the certificates were

presented to the Hon. Fellows, Sir Philip Warter, and the Rt. Hon. Viscount Swinton, P.C., G.B.E., C.H., M.C., Chancellor of the Duchy of Lancaster (not present), and to the Fellows, Messrs. R. J. T. Brown, J. H. R. Coote, G. J. Craig, D. Forrester and S. A. Stevens. A silver salver was presented to Mr. J. S. Abbott for his long and devoted service to the Society, and the programme was concluded with the Presidential Address.

Dr. Knopp described the advances which had been made recently in all sections of the industry, with particular emphasis on television and colour, and he put his finger on the salient points requiring further development and research.

Attention was drawn to the importance to all sections of the industry of The International Standards Conference in New York, which Dr. Knopp would be attending as the United Kingdom delegate.

### NEWLY ELECTED HON. TREASURER AND MEMBERS OF COUNCIL



R. E. PULMAN  
(Hon. Treasurer)

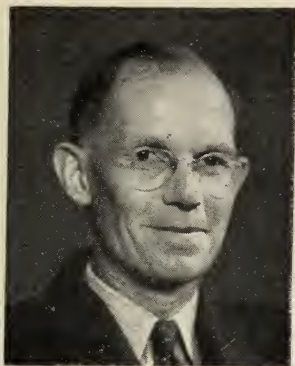
R. E. Pulman, a Fellow of the Society, has been associated with the industry for more than 25 years. Projectionist engineer for G.B. Picture Corporation for 12 years, in 1948, he became projectionist engineer for the C.M.A. Among his varied activities must be included the organisation of the G.B. projectionist training schools and lecturing on cinematography at the Polytechnic. R. E. Pulman was one of the engineers nominated to study operational methods in the U.S.A. in 1945.



DENIS WARD  
(16mm. Film Division Representative)

Denis Ward, Ph.D., B.Sc., F.R.P.S., has a background in which scientific knowledge has been closely allied to film making. During research and development work for I.C.I. he also engaged in amateur film making. Later, Dr. Ward was appointed technical supervisor for the film "This is Colour," and from this beginning the foundation of his technique was laid. Dr. Ward's professional career continued with his appointment in 1945 to The Times Film Company of Manchester. In 1948 he was appointed Managing Director of Technical and Scientific Films Ltd.





Photograph: Godfrey Lane

G. J. CRAIG  
(Member of Council)

G. J. Craig, O.B.E., a Fellow of the Society, has considerable experience of motion picture technology and in addition has a sound background in the field of electronics. He first worked under Banfield and A.G.D. West at Baird Television, Ltd., subsequently joining the Kodak Research Laboratories, from which he was transferred to the Motion Picture Film Division. During the war G. J. Craig served with the R.A.F. Photographic Research Group, when he attained the rank of Wing Commander. He is now manager of Kodak Limited Motion Picture Technical Service.



T. M. C. LANCE  
(Member of Council)

T. M. C. Lance, Chief Engineer of Cinema-Television Ltd., received his technical training at the Queen Mary College and after experience at the G.E.C. Research Laboratories joined the Baird Company in 1933. He has been associated with television development since that time, and was last year elected Chairman of the Council of the Television Society, which he has been a Fellow for many years.

## BOOK REVIEW

*Books reviewed may be seen at the Society's Library*

**FUNDAMENTAL MECHANISMS OF PHOTOGRAPHIC SENSITIVITY.** *Ed. J. W. Mitchell, Butterworth, Ltd., pp. 346, 63s.*

In recent years, a number of informal international conferences have been held with the main purpose of discussing the mechanism of fundamental sensitivity: in other words, what it is that gives the crystals in a successful emulsion their high sensitivity to light. It is characteristic for the present growth of photographic theory that a specialised subject such as this can now occupy a good two-thirds of a volume of 346 quarto pages whereas in pre-war years but a small fraction of the corresponding publications of photographic congresses would be devoted to this subject. One of the reasons is that the publication of emulsion procedures used by the German manufacturers of sensitised goods has made discussion much more fruitful in a field where information has always been most carefully guarded. There is also a greater interest amongst university research workers in the fundamental aspects of the problem. Another reason for the change in emphasis shown by the recent conferences is that some of the most important subjects of earlier discussions, e.g. sensitometry and standardisation have lost much of their appeal, presumably because most of the problems have now been solved.

The post-war series of conferences has also concerned itself with the most recent and important application of photography, the direct recording of atomic particles which form microscopic tracks of developable grains on passing through the emulsion layer. This new and powerful method has brought many problems in its train since the emulsion layers are about five times more concentrated in silver halide and up to 100 times more thickly coated than normal photographic materials. Problems of processing, of physical changes in the emulsion layers and of the interpretation of the results are of burning interest to the atomic physicist.

The present book, carefully edited by J. W. Mitchell and well printed contains all the (48) papers presented at the Conference held at Bristol University in March, 1950. Unfortunately, no record was made of the discussions. The main sections are on: Physical properties of silver halides; Production and properties of silver halide grains in photographic emulsions; Photographic sensitivity; Latent-image formation; Nuclear track emulsions.

To all serious students of the theory of the photographic process the volume will be indispensable. Unfortunately the high price of 3 guineas will prevent the wide circulation it deserves.

W. F. BERG.

## THE PRESIDENTIAL ADDRESS

Leslie Knopp,

M.B.E., Ph.D., M.Sc., M.I.N.A. (Fellow)

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**T**HIS is the second Presidential Address which I have had the honour to present to the British Kinematograph Society.

Last year, I took the somewhat unusual step of giving in broad outline the economic and political history of the motion picture film industry in this country. I had intended to follow this by presenting to you a companion history of the technological developments that have taken place during the last half century. On second thoughts, however, I have come to the conclusion that the principal features of these developments are already well known to you and that no useful purpose would be served by reiterating them. It is, I think, more pertinent to our present needs to consider the current technical trends within the industry and to enquire whether our recent researches and developments are adequate.

### The Place of Television

I think you will agree that the subject most present in the minds of those in all sections of the film industry is the impact of television. There is a wide cleavage of opinion within the trade as to how this new vehicle for public entertainment should be treated, and such cleavage of opinion is not unusual when large and important developments are fore-

shadowed. There are many who advocate that all possible steps should be taken to oppose or at least retard its development, and there are others whose opinion is that every assistance should be given to the advancement of television because such advancement can only be mutually advantageous. It is not for me to say which of these views is correct but if we turn to history we shall find it proved over and over again that there is no human power—be it church, principality or state—be it closely organized labour movements or capitalistic monopolies or cartels—there is no power sufficiently strong to arrest technical and scientific progress.

As technicians we have long since recognised that there is a wide area of ground that is common to television and to the motion picture film; we see perhaps that the area of this common ground is steadily increasing and for the purpose of interchanging knowledge and experience and to advance the technical excellence of our work, we have decided to inaugurate a Television Division within the ambit of the activities of our Society. For some years past we have worked in close harmony and co-operation with the Television Society and we hope this relationship will continue. In



our Television Division we seek to serve specialized needs. Already in the studios closed-link equipment is being used as a practical aid to producers, directors and cameramen and they are thereby gaining valuable experience in this new medium. Large screen television projector equipment has now been greatly improved, is ready for installation in kinemas and preliminary courses of training are being given to kinema and other personnel. Many of our members both in studios and in laboratories are engaged upon making films specially for television service. Thus we are equipping ourselves for the next step forward when greater freedom of action will perhaps be given to both the film industry and the British Broadcasting Corporation.

From technical standpoints we realise that much further investigation and research are necessary before these two systems of picture presentation are comparable. At the present time it is necessary, in order to obtain good reproduction, to operate television equipment well within the limits of its technical rating and much further progress is necessary in the design of television cameras and equipment in order sufficiently to reduce the luminance transfer distortion and the spurious effects which, although not over objectionable on small domestic sets, cannot be accepted on large screens.

### Technical Limitations of Television

It must be admitted that at the present time and under normal circumstances, a televised picture is inferior to that given by the motion picture film and conversely the picture reproduction of a film over a television system cannot approach the quality of direct projection. The reasons are not far to seek. Perhaps the most basic limitation is the restricted total contrast range of the television camera ; whereas the luminance range of the average 35 mm. picture may be about 40 to 50 : 1, that of a television picture is perhaps about 18 to 25 : 1. Furthermore, within this range the contrast or, in the electronic engineer's range, the linear relationship between brightness and voltage

output is not constant ; the low intensities and the highlights of the picture are very seriously compressed. Research work is afoot to reduce these deficiencies ; the Super Emitron and the P.E.S. Photocon cameras, still in their experimental stages, show considerably improved transfer characteristics but much further progress is necessary before their performance is comparable with the optical camera and it would seem that a very much larger television camera format will be necessary for taking scenes intended for direct projection in kinemas. Meanwhile, compensation must be provided electronically by modulating amplifiers, by working within the limits of the camera performance, and by careful control of studio lighting. There is, of course, a limit to which studio lighting can be controlled—a limit which is perhaps extremely difficult to determine, for while a flat scene is the ideal for television transmission, artistic expression frequently demands a maximum of contrast.

At the present time the engineer and the producer are working together within a very large area of compromise. This area must of necessity diminish and its centre must shift towards a higher standard and it is to those engaged in the design and manufacture of television cameras that we must look for greater advances and greater perfection. The present is not the appropriate occasion to deal with the many other spurious effects introduced into the television picture by cameras and by transmission systems. These effects are well known and must be removed before televised pictures projected onto kinema screens can approach equality with those projected from a motion picture film. Furthermore, there are additional problems of definition and the like which are closely associated with scanning raster, transmission frequencies, etc., which can be solved only when facilities are provided for special transmissions for large screen reproduction. Until such facilities are provided there will be insufficient stimulus and support for these further vital investigations.



### Films for Television

Those who are engaged upon the production of films for television transmission also have their problems. They must make themselves conversant with the deficiencies of the transfer medium, the characteristics of pick-up devices, the tendency of blacks to "bleed-off" into greys, flare, halo, electronic fogging—the degradation of tone contrast and the degree to which these deficiencies may be alleviated photographically or controlled electronically within the television transmission system. They must learn, too, what are the photometric characteristics of film best suited to television transmission; there is, I am afraid, a tendency to treat gamma as the only parameter but this yardstick in itself is unsatisfactory. The density range of prints is of importance not only as far as transfer characteristics of the cathode ray tube are concerned but also as regards the determination of the lowest significant density for an adequate signal to noise ratio at low levels, or, in other words, where to place the toe of the H. and D. curve. There are many other variable factors which determine the suitability of a print for television purposes and it is apparent that there is a growing need for a close investigation into these matters and for the preparation of suitable standards or codes of practice. These are some of the many current problems to be faced. The solution of these problems depends upon a closer co-operation between the television engineer and the film technician and it is to be hoped that the Television Division of the Society will form a suitable channel for the interchange of knowledge and a common pooling of experience.

### The Place of Colour Kinematography

Turning from television, the least informed observer will recognise that there is, at the present time, a greater emphasis being placed upon the production of colour films. This may be due to some inherent feeling that it is a suitable competitive factor to television, or it may be that this is merely coincidental and the emphasis is due to the considerable

improvements that have recently taken place in the manufacture of integral tri-pack colour stock. It is, however, certain that colour films are accepted and preferred by the public and the use of colour will steadily increase providing only that such films can be produced and processed economically.

I think that with a little more experience and knowledge production costs can be reduced to a basis comparable with those of black and white but the present high costs of film processing are a serious retarding factor. The processing speed of colour film is about one sixth of that of black and white and consequently for the same output it is necessary to extend existing machines or to install additional ones—either of which solutions involves considerable capital expenditure and increased overhead charges. This situation is perhaps inevitable but another important factor involving higher costs which could be more easily controlled is that the processing technique of each of the five principal tri-pack film stocks on the market is different in some measure. There is an erroneous impression afoot that these materials are interchangeable. It is true, of course, that the positive material of one manufacturer may on occasion particularly suit the colour balance of a negative of another make, but this is just a fortuitous circumstance; the processing techniques are very dissimilar and involve the laboratories in much unnecessary expense and trouble. If the manufacturers of these colour stocks have the welfare of this industry and indeed their own success at heart, they should collaborate without delay with the object of providing uniformity in processing technique. If this Presidential Address served no purpose other than to bring these manufacturers together whether under the aegis of the British Kinematograph Society or the British Standards Institution or the Association of Photographic Film Manufacturers, I would be well satisfied.

### Necessity of Standardisation

Apart from these economic questions there are many photo-chemical and photo-optical

problems still to be solved and although each laboratory may endeavour to work out its own solution, some form of standardization and uniformity is clearly desirable. In colour work there still remain too many variables that are beyond easy or adequate control and until we are able to exert a rigorous control over these variables during processing, we shall not be masters of our medium. Colour sensitometry and densitometry are subjects receiving considerable attention at the present time and it well may be that in the near future there may be uniformity and simplification in both the instruments used and the methods employed. Opinion seems to be divided as to whether sensitometric test exposures should be on the time scale basis as with black and white or on an intensity scale. Some favour the former because of the difficulties involved in varying accurately the light source intensities or in obtaining sufficiently accurate colour-free step wedges ; others favour the latter because of the difficulties of reciprocity failure associated with the time scale tests. The simplification of sensitometric tests is essential and it is desirable that means be provided simultaneously to combine selective exposures of each emulsion layer to produce subtractive colour separately and to expose in combination to obtain a grey scale. Similarly, it seems that the analytical densitometer is preferred to the integral type, although both have their appropriate uses. I am of the opinion that there is a necessity for an instantaneous and automatic colour analyser giving simultaneously analytic and integral readings, and with the aid of the electronics engineer it would be possible to produce a compact and reliable instrument which would indicate on a double-beam oscilloscope, or if preferred, on two separate cathode ray tubes, any deviation in negative or positive print from a predetermined colour balance or indeed from a predetermined grey scale. At the same time such an instrument could indicate the filter correction factors to be applied to restore any deficiency in colour rendering of a negative to the predetermined standard conditions. By a few shots of standard

greys before each shooting sequence, each negative could be graded automatically after processing and the subsequent printing control for positives would be similarly automatic.

### **Imperfection of Colour Processes**

The initial predetermination of a standard colour balance would be obtained from wide subjective quality judgment but once the balance were determined, it would remain constant for all normal purposes and the only deviations that need to be introduced would be for any special effects desired by the producer or art director. This subjective quality judgment is necessary because we accept as a satisfactory representation of a scene, a picture in which the colours, when analysed, are different from those of the objects represented.

All modern processes of colour photography desaturate practically every colour that they reproduce, but in spite of this physical desaturation, the subjective appearance of most colours in a screen picture are regarded as satisfactory if the overall balance is pleasing. In appraising the colour of an object in a screen picture, the standard of colour against which it is judged consists of a conception in the memory, and this conception, in the majority of cases, is vague. This being so, the desaturation unavoidable in colour photography often passes unnoticed by the public, and the fact that it is looking not merely at a collection of colour patches, but at an animated picture with artistic and emotional appeal, tends further to obscure such imperfections in reproduction.

The criterion is, of course, a pleasing and satisfactory balance of colour rather than colour accuracy—and this balance, in the ultimate is a question of quality judgment.

### **Colour Content of Screen Light**

Whilst a large amount of thought and scientific application is being given to the improvement of colour films, I am afraid that companion improvements are not being effected in our kinemas. Little or no



research work has been done with regard to the colour quality of projector light sources and screen luminance is still standardized within the very wide limits of 8 to 16 foot lamberts. To achieve the finest results with colour film the projector system should have a light source with a fixed visual spectral distribution which could be specified as that of a black body raised to an appropriate temperature, or otherwise specified, and whilst some types of high intensity carbon arcs meet our requirement, comparative readings taken in cinemas show in some cases deviations from as much as 18 per cent excess of red to 12 per cent excess of blue. Comparative measurements only can be taken readily but nevertheless, such measurements are of considerable use. I am of the opinion that from a wide variety of individual subjective quality judgments it would be possible to determine a datum for a "standard observer" and this datum could be used for screen colour appraisal in cinemas. Such comparative measures may be better for practical purposes than a full spectral analysis and will more quickly disclose colour deficiencies or excesses in screen luminances. It is only by preliminary tests that I have made that the wide differences in colour content of screen light have been disclosed but I have also found on the other hand, that under good operating conditions the spectral distribution of radiant energy between about 4,000 and 7,000  $\text{\AA}$  of a suitable combination of high intensity arc carbons can be kept within 2.5 per cent of that of a black body at 6,200 to 6,300 K.

### Need for Research

It must be recognised that a large quantity of basic data on the factors affecting the viewing of colour pictures and indeed of black and white, remains to be determined; in point of fact the problems have not yet been stated properly and succinctly and I feel that for the physiologist, the psychologist and the industrial or perhaps the university research worker, there is a wide and almost virgin field for future investigation.

Similarly there is a wide field for research in the acoustic measurements of kinema auditoria and of studios. It has been recognised that the reverberation period or the overall frequency characteristics of an enclosed space are not the only criteria of good conditions for listening or for sound recording. The results so far achieved by the sound pulse technique are sufficiently promising to warrant further investigation. It is pleasing to note that from the pioneer work carried out by two members of this Society, the British Broadcasting Corporation are conducting further research and some of their results have already been published. It is a little too early to attempt confident interpretation of these results but it would seem that the characteristics of the initial decay of sound are of more importance than overall reverberation time. The diminution of discrete reflections should, it seems, be at least 20 to 25 decibels if they occur more than 50 milli-seconds after reception of the direct sound and rapid changes in the acoustic impedance of auditoria should be avoided. The positioning of absorbent material should be arranged with this in view, and in the design of new auditoria and studios greater attention will have to be paid than hitherto to the requirements of good sound reproduction.

### Developments in Magnetic Recording

An important development in sound engineering during the past year is the widespread adoption of magnetic recording in all the major production studios in this country. This is principally on account of the economy and high efficiency of magnetic recording.

For studio work film or tape having an iron oxide or other magnetic track is used but there remains some uncertainty as to what dimensional standards will be finally adopted. Film gauges of 16mm., 17.5 mm. and 35mm. and the standard tape width of 0.25 in. are all in use, and whilst interchangeability between studios is not an essential at the present time, standardisation of both gauge and track position is desirable.



Within studio installations, unperforated tape is used to some extent for non-synchronous sound, but perforated magnetic film is normally employed for all synchronous work. Synchronising procedure is the same as that employed for photographic recording and indeed, many of the recorders used appear to be photographic machines which have been converted to the magnetic system.

For location work, the sound recording truck fitted with a studio channel (or a simplified version of it), is still used for some types of work, and transportable sprocket driven magnetic recorders have also made their appearance.

I note, however, that unperforated tape is being used on an increasing scale, and several feature studios, together with the majority of small production units specialising in location work, now use equipment employing this medium. Early difficulties in synchronising have been overcome by one English company, which has developed an ingenious system employing a pulse modulated control track. This track is recorded alongside the speech track. The pulses on the control track are derived from the associated picture camera and represent the frames turned by it, thus ensuring that synchronism is as precise as with the more conventional perforated tape.

By operating both picture camera and sound recorder from separate local batteries, no A.C. need be generated for synchronising, and the whole equipment is kept light and portable. Thus, in both studio and location sound recording, considerable advances have been made towards higher efficiency and lower operating cost.

At the present time magnetic recording is used as an intermediary step in the production of sound films and the sound so recorded is transferred photographically onto release positives. Time is not far distant, however, when magnetic recording may be used exclusively. Already it is being widely employed on 16mm. film and there are projectors on the American market fitted with both magnetic and optical sound heads.

Such a projector will be available in this country within the next few months, and this innovation will mark another forward step towards higher fidelity.

### **The Latensification Process**

Manufacturers of film stock are already alive to this development but I think you will agree that the greatest progress that has been made by these manufacturers is the latensification process which is now past its experimental state and is a trustworthy and reliable means for increasing the sensitivity of film stocks. Much research work has been conducted on photographic emulsions and one British company has now succeeded in producing an emulsion having a speed of 400 Weston or 37° Scheiner, which is 4-5 times faster than any known product. This emulsion is not at the moment available on kinematograph film but it is hoped, as work further progresses, that it will become available.

### **Safety Film**

It may be reported that the production of cellulose nitrate film in this country has altogether ceased and except for a small quantity of nitrate film being imported by a Continental manufacturer, all new positive release prints are on tri-acetate base. It has been stated that only 10-15 per cent of film at present in use is on cellulose nitrate base and the time is fast arriving when it will be to the advantage of the renting and exhibiting sides of the industry to get together to agree mutually to the exclusive use of safety film. Such an agreement would involve reprinting some of the older films that find their way out of the industry's archives on Sundays but this would not be a costly matter when compared with the advantages that would accrue. It must be remembered that a new Cinematograph Bill is at present making its progress through Parliament and before the close of the present Parliamentary session we shall have a new Cinematograph Act; this is an enabling Act and gives the Home Secretary powers to publish regulations for safety, etc., and it will be materially to our advantage

that when these new Regulations are to be discussed we are able to say that safety film is being used exclusively throughout the cinematograph industry and that the fire and explosion hazards associated with nitrate film no longer exist. The introduction of safety film has not been without its teething troubles, although it would seem that the changeover has been more smoothly and efficiently carried out in this country than in America, and there is some pleasure in recording the fact that there is considerably less damage and mutilation occurring with this material. It may well be that this is largely due to the result of the work of the Industry's Film Damage Advisory Committee; this Committee has done some outstanding work in solving the more fundamental causes of unnecessary damage to film stock, and supported by all the trade organizations it has issued recommendations to all concerned in the handling of film. Additional recommendations have recently been published and it is hoped that they will be the means for a substantial reduction in film damage and the consequently heavy reprinting costs.

### Standardization

Finally, reference must be made to work on standardization which has progressed steadily during the year. The British Standards Institution has 26 Committees in addition to the Industries Committee, which are engaged on the preparation of new standards or the revision of old ones. Draft specifications covering standards for studio spotlights, rectifiers for arcs, stage electrical equipment, photo-electric cells for sound film apparatus, screen luminance, and lenses for sub-standard projectors have been prepared and are about to be circulated for comment before they are finally published. A Joint Committee of the British Standards

Institution and the Institution of Electrical Engineers was set up during the year to investigate the lighting of kinema auditoria with particular reference to safety and primary maintained lighting. A draft Code of Recommended Practice has now been prepared and when this document is published in the very near future, it will prove a valuable guide to those who are modernising or relighting kinemas.

It may be appropriate for me to inform you that the first International Standards Conference on cinematography is to be held in New York next month for the purpose of co-relating several national standards. The work to be undertaken involves discussions in connection with emulsion and sound record position in cameras and projectors, the dimensions and locations for sound records and scanning areas, the location and size of picture apertures in cameras, projectors and printers, definition and test of safety films and various standards relative to kinemas. I have had the honour of being nominated a British delegate to this Conference but I regard it not as a personal honour but rather as a recognition of the status of the British Kinematograph Society of which for the time being I am the President.

### Conclusion

Ladies and gentlemen, I have presented you with a broad but perhaps superficial review of the advances that have been made in this industry within the recent past and I think you will agree that we have achieved a measure of progress of which we well might be proud. Much, however, still remains to be accomplished and I am sure that the British Kinematograph Society and its members will play their part in the future as they have in the past, and that we may look forward with considerable confidence to what lies ahead.

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# MAGNETIC SOUND ON 16 mm. EDGE-COATED FILM

## A Short Review of a Current Trend

THE recording and reproduction of sound by means of magnetically coated film has been so developed in recent years that from the point of quality, signal-to-noise ratio and ease and economy in use it is one of the best available methods.

It was demonstrated as long ago as March 1947 in America that a processed 16mm. silent print on single-perforated stock could be successfully edge-coated with iron-oxide.<sup>1,2</sup>

### Advantages of New Technique

The new technique would seem to offer considerable advantages for certain circumstances :

- (1) A wider frequency range appears to be more easily attainable than with 16mm. photographic recording.
- (2) An improved signal-to-noise ratio is certainly possible.
- (3) The sound track can be wiped and re-recorded or corrected at little or no cost.
- (4) 16mm. sound films with obsolete tracks could be "striped" and furnished with new sound tracks.
- (5) Educationalists, whose resistance to sound films is usually centred on unsuitable commentaries, could provide their own commentaries without great expense.
- (6) Commercial film sponsors would be able to send striped films abroad with a written commentary which could be translated and recorded in any language.
- (7) The method would prove most popular with the amateur 16mm. user.

These possibilities have remained impracticable commercially until recent months. Lately, in the U.S.A. some of the foremost manufacturing companies in the 16mm.

sound projector field have produced new models which make these possibilities realisable.

### New American Models

#### *Filmosound 202*

The Bell and Howell Company of Chicago has produced a version of its well-known 16mm. projector to be known as the Filmosound 202 (Figs. 1 and 2). The new model appears to be similar to the normal Filmosound projectors in most ways but it provides the following additional features :

- (1) The choice of either magnetic or photographic reproduction at the turn of a switch.
- (2) Recording and erase facilities.
- (3) Microphone and disc inputs to the recording head.
- (4) Magnetic recording and reproduction at either 16 or 24 frames per second.
- (5) A Yale-type lock and key on the record-erase control.

#### *RCA 400\**

The RCA Company has also produced a development of the RCA 400 16mm. projector (Figs. 3 and 4) offering the additional facilities of magnetic recording and erasure.

The modern version of the RCA 400, which the writer has had an opportunity of examining, is at present produced only in the U.S.A. It carries an erase head adjacent to the feed sprocket and an ingenious recording head behind the fluid fly-wheel reproducing drum. The erase head must be moved over a wide arc to reach the erase position but the record head is only one thousandth of an inch below the surface level of the sound drum and is

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\* Editor's Note : This projector was incorrectly illustrated in the April issue of **BRITISH KINEMATOGRAPHY**.



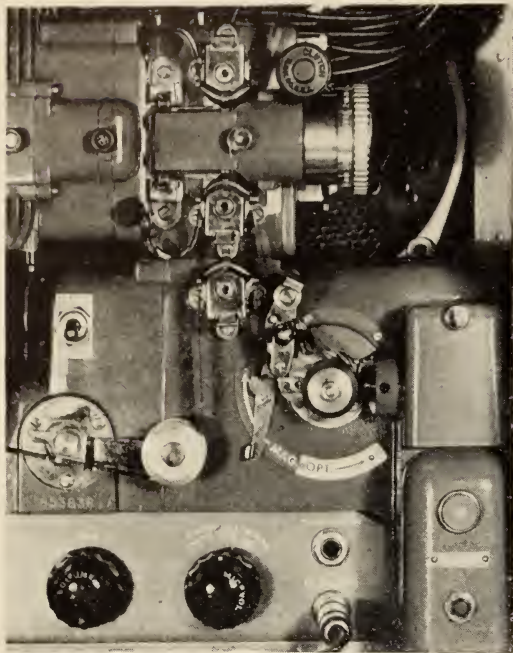


Fig. 1.

*The Bell and Howell Filmosound 202 showing the sound head. The Magnetic/Optical changeover device is clearly seen.*

raised into contact with the film automatically when switching from photographic to magnetic track. The projector gives only one speed—24 frames per second.

### *The Ampro Model "477."*

The Ampro Model "477" Magnetic-Optical Recording projector (Fig. 5) has been designed for the high fidelity sound that is obtainable from a magnetic sound track on 16mm. film, and has a useful response range from 55 to 12,000 cycles/sec. and 45 to 50 db dynamic range. At the 55 and 12,000 cycles/sec. points, useful signal levels of from 25 to 30 db above noise level are obtained. The performance of this projector provides sound quality on 16mm. film available formerly only from professional 35mm. optical sound equipment.

The record-play head cartridge is placed outside the sound drum. The suspension is of very low mass and pivoted close to the cartridge-film contact point to ensure perfect contact at only 15 grammes head pressure. Micrometer adjustment screws for parallelism, azimuth and lateral position can be reached with ease.

The design of motor shield, head shields and head cartridge, and provision of hum nulling adjustment for motor head assembly and amplifier input transformer, make possible unusual dynamic range. Silent speed recordings are only a few decibels lower in dynamic range and a fraction of an octave narrower in frequency response range.

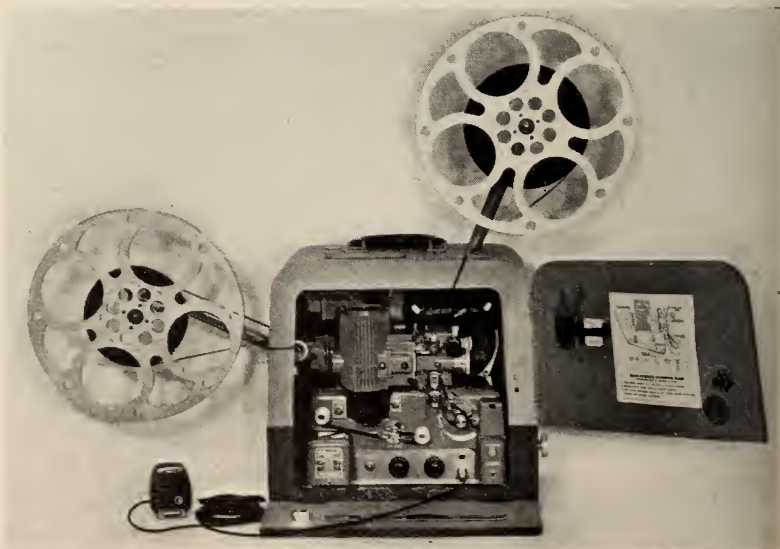


Fig. 2.

*The Bell and Howell Filmosound Model 202.*

The projector will reproduce either optical or magnetic sound separately or, by use of a 50 mil magnetic coating track over half the optical track, the projector can be made to play both optical and magnetic sound at the same time or independently as selected. Full magnetic track coating 100 mil wide on part of a film and the balance of the film having optical sound can be played through the Ampro Model "477" without the necessity of switching or stopping the projector. With half track it is possible to record on the magnetic track while playing back optical sound track. This could be used for translation work.

The recording amplifier is of the remote control type and is linked to the projector by a fifteen foot cable which can be lengthened by means of extensions. The projector motor may be started or stopped and the projection lamp turned on and off from the remote control point, which may be in a review room while the projector is located in a projection booth or other room, thus eliminating the pick-up of projector mechanical noise. A low level microphone channel and high level radio-phone or tape recorder channel, are provided at the control panel with individual volume controls for mixing the two channels on the final recording.

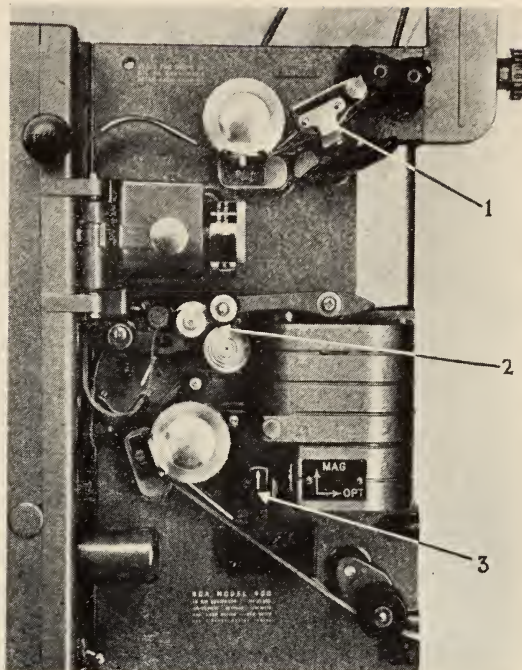


Fig. 3:

*The RCA projector showing :*

- (1) The erase head in the "ERASE" position. It is seen in the parked position in Fig. 4.
- (2) The recording head, which is housed behind the reproducing drum and is automatically raised into the "RECORD" position when
- (3) The Magnetic/Optical switch is turned to magnetic.

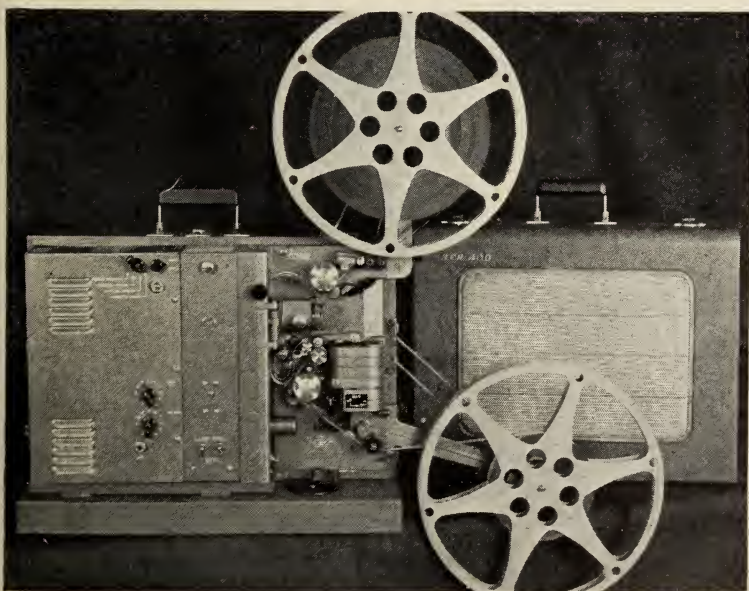


Fig. 4.

*The RCA 400 projector for magnetic or photographic sound. The speaker unit is seen on the right.*



A V.U. meter is provided for visual monitoring of the recording signal levels and adjustments of the relative levels during mixing. A record play switch selects the amplifier function and a red indicator lamp prevents accidental mispositioning of the switch.

It is possible to record a narrated track on a magnetic coated film and at a later date record a musical background without erasing the narration.

A monitor jack provides a source for ear-phone listening during either record or playback functions.

amplifier system will also be necessary, the change will not be a very simple one.

Magazine cameras and other 16mm. cameras in which the sprocket teeth and claw are on opposite sides of the film will present a problem to those wishing to have reversal film striped. Some cameras will prove easy to modify for single perforated film but many others will necessitate a duplicating step before striping is possible.

In America the edge-coating operation is being carried out by several companies, with experience in tape coating, offering the service. The Bell and Howell Company

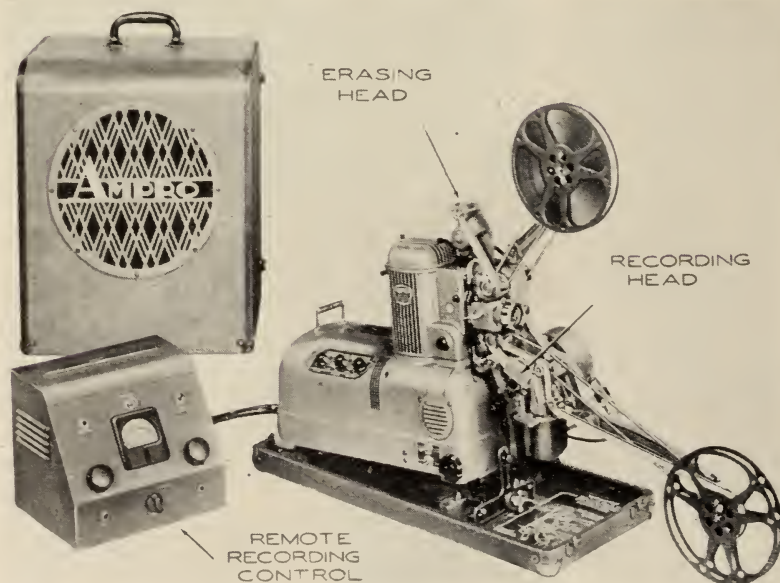


Fig. 5.

*The Ampro Model "477."*

The Ampro Model "477" has silent and sound speeds, still picture and reverse.

Although no announcements have been made in this country there is no doubt that similar developments are afoot and will be eagerly awaited.

#### Modification of Existing Models

In the case of some 16mm. projectors already on the market it may be possible to produce additional components so that a modification to magnetic/photographic sound is possible but, since modifications to the

itself offers Soundstripping, as it is called, at 3½ cents per foot with a 48 hour service. Half-track striping is offered giving both magnetic and photographic tracks on the same print. This, in spite of obvious disadvantages, appears to have its uses when the photographic track is suitable for such restriction.

It would seem logical, if the new technique becomes popular in the United Kingdom, for the striping operation to be carried out by the usual processing houses. The delay and the additional transport and handling in-



volved in collecting prints from the normal laboratory and sending them elsewhere for striping would seem largely to counter one of the great advantages of the new method where topical films are concerned—the time-saving factor.

The half-striped track which the writer had heard has suffered from the defect that when reproducing the photographic half of the track the full track width is illuminated by the light slit which is thus modulated by the edge of the magnetic striping. Unless the striping is very carefully coated, the resulting interference in the photographic reproduction can be devastating.

### Placing of Magnetic Coating

Although there is no accepted standard, with so many sound projectors in use there appears to be little prospect of a change from normal in the position of the magnetic sound track in relation to the perforations; the magnetic coating can be applied to either side of the film although it is in fact usually applied to the base side.

It may prove advisable to apply a dummy coating of equal thickness to the outside edge of the perforations in order that the roll of film shall wind up in a uniform and symmetrical fashion although, as yet, this practice is not common.

It is reported that efforts are being made in the U.S.A. to apply a magnetic stripe to the rebate on double perforated 16mm. film. In view of the high quality now demanded by the user of 16mm. sound films there seems little likelihood of a successful outcome.

### Conclusion

In conclusion, it does not look as though the new technique will rival the normal 16mm. photographic sound method where feature films are concerned or where a large number of prints is needed, but for specialised uses in the commercial, industrial, educational and amateur fields the advantages are considerable and fresh horizons will appear for many who have hitherto considered 16mm. sound on film too difficult or too expensive to use.

R.J.T.B.

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3. Masterton, E. E., Putzrath, F. L., Roys, H. E., "Magnetic Sound on 16mm. Edge-Coated Film," *J. Soc. Mot. Pic. and Tel. Eng.*, **57**, 6, Dec., 1951.
4. Valle, G. A., Putzrath, F. L., *J. Soc. Mot. Pic. and Tel. Eng.*, **58**, 5, April, 1952.

### BOOK REVIEW

*Books reviewed may be seen at the Society's Library*

#### TELEVISION PRINCIPLES AND PRACTICE.

*F. J. Camm, George Newnes, Ltd., pp. 215, 25s.*

F. J. Camm is well known as the Technical Editor of George Newnes, Ltd., and his latest book on Television is an excellent introduction to the technical side of Television. Although written primarily for serious amateurs and television service engineers, much useful information on how the B.B.C. television system functions will appeal to the non-technical viewer.

The latest types of television cameras employed by the B.B.C. are well described.

A long chapter giving some useful information on current television receivers is included together with a short chapter on stereoscopic and colour television.

The chapter dealing with television servicing should prove most helpful to those ambitious enough to build their own television receivers and will also assist the less ambitious but keen viewers to adjust their receivers correctly to obtain the best quality television pictures.

A dictionary of television terms is included which will assist those who wish to read original papers on the development of television.

It should be emphasised that the picture on page 5 is of the Alexandra Palace transmitter control desk; there are one or two obvious errors in the book, but these are commendably few, and the author and publishers are to be congratulated on the high standard achieved in this respect.

W. H. CHEEVERS.

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## THE COUNCIL

*Summary of the meeting held on Wednesday, June 4th, 1952, at 164 Shaftesbury Avenue, W.C. 2.*

**Present :** Mr. H. S. Hind (*Deputy Vice-President*), in the Chair, and Messrs. R. J. T. Brown (*Hon. Secretary*), R. E. Pulman (*Hon. Treasurer*), G. J. Craig, F. S. Hawkins, T. M. C. Lance, N. Leever, S. A. Stevens and D. Ward.

**In Attendance :** Miss J. Poynton (*Secretary*).

**Apologies for Absence.**—Apologies for absence were received from the President, the Vice-President, the Past President and Mr. T. W. Howard.

**Liaison Committee :** Under the chairmanship of Mr. H. S. Hind, the Council has appointed a Committee to maintain liaison with the British Standards Institution on all matters relating to standardisation.

**1953 Convention.**—The following *Ad Hoc* Committee has been appointed to draft proposals for the Coronation year convention:—

Messrs. R. J. T. Brown (*Chairman*)

A. Challinor

B. Honri

T. M. C. Lance

D. Ward

### COMMITTEE REPORTS

**Membership Committee.**—The following are elected :

Roger William Gordon Bennett (Student), Circuits Management Association, Ltd.

Thomas Leslie Rann (Associate), Hickson & Welch, Ltd., Ings Lane, Castleford.

Albert Jessop Evans (Associate), Associated Tower Cinemas, 41, Park Place, Leeds 1.

Harold William Wilson (Associate), Tower Cinema, Leeds.

Philip Hoghton Dorté (Member), British Broadcasting Corporation, Alexandra Palace, N.22.

Archer Michael Spooner (Associate), British Broadcasting Corporation, Designs Dept., Room 301, Brock House, Langham Street, London, W.1.

William David Buxton (Associate), Ritz Cinema, Vicar Lane, Leeds.

The following is transferred from Associateship to Membership :

William Harold Cheevers, British Broadcasting Corporation, London, W.1.

The following is transferred from Studentship to Associateship :

Tore Breda Thoresen, Lybekkveien 39A, V. Holmen, Oslo, Norway.

*Report received and adopted.*

**16mm. Film Division.**—Films of particular technical merit will be shown on three occasions during the 1952/53 session. The programme is being arranged, and the full details will be published later.

*Report received and adopted.*

**Film Production Division.**—A recommendation has been submitted to the Education Committee that two courses of study shall be arranged during the coming session. The first, on Colour Kinematography, and the second, on Colour Film Processing and Colour Sensitometry.

*Report received and adopted.*

The proceedings then terminated.

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# BRITISH KINEMATOGRAPHY

VOLUME 21 No. 2

HON. TECHNICAL EDITOR :  
R. J. T. BROWN, D.S.C., B.Sc. (Fellow)

AUGUST, 1952

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## THE KODAK MUSEUM

FOR visitors to the Kodak Works at Wealdstone one of the most fascinating places of call is the Museum, where a comprehensive collection of specimens and apparatus covering all fields of photography is on display.

The Kodak collection, indeed, ranks with those of the Science Museum, South Kensington, and the Royal Photographic Society as one of the three major displays of historical photographic apparatus in Great Britain. Here can be seen, for example, a microfilm used in the pigeon post to Paris during the Franco-Prussian war of 1870, or in a similar group, the first Airgraph sent from Cairo during World War II ; a Standard Candle of 1860, used as a basic unit in photometry, and a sensitometer sector wheel employed by Sheppard and Mees during their fundamental researches in 1903.

Of more direct interest to members of the British Kinematograph Society is the Motion Picture section, where can be seen among many interesting exhibits, Lumière's Cinématographe, a combined 35 mm. camera and projector built in 1895 ; the Newman Sinclair Aeroscope, a 35 mm. camera of 400 ft. capacity driven by compressed air ; a 35 mm. film having circular perforations, made by Lumière in 1895 ; a two-colour Technicolor print made in 1916 ; and a variable area sound record prepared by Lauste in 1906.

B.K.S. members are invited to visit the Museum, which is open daily from Monday to Friday. Arrangements for visits should preferably be made through the Motion Picture Film Division, Kodak Limited, Kingsway, London, W.C.2.

G. J. CRAIG.

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## HIGH-DEFINITION FILMS

Norman Collins\* and T. C. Macnamara,\* A.M.I.E.E

*A Summary of joint paper read to the Film Production Division and divided into two parts, the first delivered by Norman Collins on February 20, 1952, and the second by T. C. Macnamara on March 19, 1952.*

THE authors reviewed the current situation in the film industry, and drew attention to the unavoidably high costs of production, which derived in large part from the production methods at present employed.

It was pointed out that as a result of these costs the risks of picture-making have become very real, and for every picture which shows a substantial return on capital invested, many only just break even and many make serious losses.

Attempts have been made to reduce production costs and many expedients have been tried, but without significant success. The failure to reduce costs significantly without spoiling the product is above all due to the limitations imposed by the optical camera, which, despite improvement out of all recognition in technical detail, remains essentially the same instrument as in the days of Lumière and Friese-Green.

### Limitations of the Optical Camera

The limitations of the optical camera centre on the fact that no one except the camera operator can have a true picture of what is being shot during a take, and the director is therefore compelled to rely on his powers of judgment and imagination to visualise the nature of the shots, which he cannot see until rushes are projected—probably the next day.

In consequence, he must, at the expense of a great deal of footage, safeguard himself by a repetition of takes until he can be sure that he is bound to have not only one entirely satisfactory shot but sufficient material to cut into a finished sequence.

The employment of more than one orthodox camera in a continuity sequence is considered to be entirely impracticable—a view in which most film-workers concur—not

least because of the artistic hazards that are involved, and because the lighting cannot be satisfactorily contrived in the absence of exact and continuous observation of the result.

The accepted method of production has, therefore, been evolved of sheer necessity, i.e., the results of a day's work are assessed later, generally on the following day, and the final product is assembled piece by piece in the cutting room. In consequence, the finished output is unavoidably confined to some two or three minutes a day. This represents an inevitably costly method of working and the cost is multiplied if, at a late stage, some deficiency becomes apparent in the production which necessitates second thoughts and reassembly of cast.

In the authors' view, film-making cannot be appreciably speeded up or the costs substantially reduced, so long as purely optical methods remain in use. If, on the other hand, electronic methods are employed, most of the present difficulties disappear, and new and (in film-making) as-yet unexplored advantages become apparent.

### The Electronic Process

In essence, the electronic process makes use of high-definition electronic cameras (i.e., cameras of a definition corresponding to that of orthodox kine-cameras as at present employed) on the studio floor, with their outputs concentrated at a central control point where the director can observe the picture from each of a number of cameras simultaneously displayed on a separate viewing screen.

By means of instantaneous switching, he can select the output of any camera to contribute to the completed picture which he observes on his master viewing screen. Facilities are provided for all types of fades, mixes, wipes, superimpositions and the like,

\* High-Definition Films, Ltd.

and also means for mixing in location material, etc., by electronic film-scanning apparatus.

Development work is currently proceeding on methods by means of which all forms of electronic process shots may be assembled and mixed in by the operation of a switch, including back-projection, static and travelling matte, glass shots, etc. The introduction of such process shots is thus immediately under the control of the director who can observe the effect upon his master screen without any delay.

Complete continuity rehearsal before cameras, including inserts of exteriors and process shots, is therefore possible. In consequence, much of the work that would ordinarily be done in the cutting room subsequent to shooting with optical cameras, can be despatched on the actual floor before the film is shot.

The certainty with which this can be done and the assurance that the requisite effect will be secured arises from the fact that the complete result can be seen by the director on his master screen, and also by any number of other people each of whom can be provided with similar screens distributed throughout the studio.

### Multiple Camera Working

The authors contend that with the increased facilities that electronic cameras offer, multiple camera working becomes entirely feasible in a very large proportion of sequences, with a manifest economy in time. The argument that lighting for more than one camera at a time is not practicable, while accepted as valid in the case of the optical camera, is not accepted when electronic cameras are employed.

Their view is strengthened by knowledge of the high and controllable sensitivity of the electronic camera and the fact that its transfer characteristics can be instantaneously varied over wide limits, enabling slight lighting deficiencies to be compensated by electrical adjustments.

During the actual take, the recording of the image on film is achieved elsewhere by

means of photographic cameras focussed upon the screens of high-intensity cathode-ray tubes, operated in parallel with the director's master screen and arranged for continuous taking.

### Transfer Characteristics

Compensation for the overall photographic transfer characteristic can be introduced electrically into the recording cathode-ray tube circuits so that the final result, when projected on the screen in a theatre will be an exact reproduction of the picture seen on the director's screen, without alteration due to the photographic processes.

By this means, every scene composed and displayed on the master screen is faithfully recorded on the film and, at the end of a day's work the product is a complete, rough-edited section of picture, in continuity, including all opticals and process shots and requiring only the minimum of subsequent cutting. The authors particularly emphasize that the extent of the subsequent cutting remains a matter for the director's discretion ; at the two extremes the resultant film at the end of a day's shooting, with electronic cameras, can be regarded either as " finished " film or rough assembly.

Already the possibilities of the process have been partially realised and attempts have been made to exploit them by attaching an electronic camera to each optical camera to serve as a remote viewfinder.

By this means the director can observe the scene from the viewpoint of each camera and, by remote control, can start the optical camera, that he has selected for the particular take, thus exposing the film in the normal manner.

In the authors' view this represents a considerable advance in technique, but they consider nevertheless that it goes rather less than half way to a full realisation of the advantages of the electronic method.

In the first place, the addition of the electronic unit to the normal camera increases the bulk and weight of an already inconveniently large and heavy instrument.

Secondly, the elimination of parallax and

the maintenance of precise limit relations between the two systems present serious difficulties and tends to undermine confidence in the viewfinder.

Thirdly, the necessity for reloading cameras on the floor remains and automatically limits the length of take which is possible, and, finally, the introduction of all types of electronic "process" shot is entirely ruled out, so that the necessity for lengthy cutting and production of laboratory "opticals" remains.

### **Advantages of Electronic Process**

The authors therefore advocate the use of the full electronic process which they have described and which possesses the following advantages :

- (1) Small, light and entirely silent cameras of high sensitivity, which require no reloading and can be operated in any position with remote focussing if necessary.
- (2) Complete ability of the director and his assistants to see every shot in its entirety, with complete control and the certain knowledge that what has appeared on the master screen has been faithfully recorded on the final film.
- (3) Unlimited length of take and the ability to make as many master negatives or positives as may be desirable, with the additional facility of quick development of a positive for immediate playback, either on the master screen or in a projection theatre.

It is accepted by the authors that the technical quality of the pictures produced by the electronic method must in no way be inferior to the normal theatrical release standard, in order that the product may be acceptable, and they are confident that, using high-definition electronic cameras of recently developed type, the requisite quality can be obtained.

### **Limitations of Broadcast Television**

They feel that there is a universal tendency to judge the capabilities of an electronic picture system in terms of broadcast television

reproduction. This in their view is an entirely erroneous basis for comparison, and they point out that the exigencies of radio broadcasting impose the most drastic limitations on television picture quality. On the score of definition, the broadcast transmission is confined by ether-space considerations, to a bandwidth of five megacycles, which must contain both vision and sound transmissions, at the same time retaining sufficient "guard-band" at the top and bottom to preclude the possibility of interference with neighbouring channels.

In consequence, the bandwidth available for the vision signal is limited in this country to three megacycles, which is a totally inadequate band of frequencies to convey the information required to reproduce a picture of sufficient detail to satisfy motion-picture requirements.

Next, the television broadcast engineer is seriously hampered in respect of contrast range and tonal gradation. He is faced with the necessity of producing the best results he can on commercial television receivers which include cathode-ray tubes, the average gamma of which is about 2.5.

This may be said roughly to correspond with the positive print in motion-picture photography, and to satisfy the requirements of this characteristic he must generate at the studio a picture having a gamma of about 0.5, which in turn is analogous to the photographic negative.

Moreover, his transmission system, including cable links, radio transmitters, etc., must have a gamma of unity otherwise the overall gamma of the system from camera to receiver would become unmanageable. The unity gamma characteristic of the transmission system is precisely analogous to a duplicate negative, where only the linear part of the film characteristic can be used, if good quality is to be maintained.

To appreciate the implication of the foregoing, it is necessary to consider the range of contrast which must be transmitted. It may be assumed that a detail-bearing range of some 25 to 1 (corresponding in photography to a range of print density of 0.1 to



1.5) must be reproduced, with extension to perhaps 40 to 1 to cover the requirements of dense black areas and burnt-out highlights.

As a result of the 0.5 gamma law of the television camera this range is compressed to 5 to 1 for the detail bearing contrast and 6.5 to 1 for satisfaction of the additional range required to give richness to the blacks and sparkle to the highlights.

In the broadcasting of such signals, however, severe limitations are imposed on the range of contrast that can be realised, because of the necessity for mixing in synchronising signals and by the ratio of signal to noise experienced by all but the nearest viewers.

Consequently it is unavoidably necessary, in the interests of more distant viewers, to occupy the whole of the transmitted dynamic characteristic by the detail-bearing range of contrast, allowing the dense blacks and glittering highlights to be flattened, with the result that the reproduced picture is lacking in sparkle.

### Difference in Systems

Leaving the limitations of broadcast television, it will be appreciated that the electronic system advocated by the authors is virtually free from all these handicaps.

To start with, the whole apparatus is operated on closed circuit under virtually laboratory conditions, without radio broadcasting and without even the necessity of having to generate a composite signal including synchronising impulses.

Next, in so far as definition is concerned, there is no significant limit to the bandwidth which may be employed. As to what is actually required, the authors consider that a picture built up from 1,000 to 1,300 television lines will permit reproduction of detail equivalent to that of a normal 35mm. motion picture. This would correspond to a bandwidth of some 15 to 20 megacycles for a picture repetition frequency of 24.

The high-definition type of camera delivers a signal at frequencies of this order, with a signal to noise ratio of the order 30 to 40 db. and cathode-ray tubes have been developed

which have a resolution of some 2,000 television lines, with a sufficient light output to permit of photography on fairly slow fine-grain film stock. Film of the fine-grain type has the advantage that the definition of pictures recorded on it, is proportionately less degraded in subsequent processing and printing than is the image recorded on faster, coarser-grained emulsion.

Reverting to the question of contrast range and tonal gradation, complete control of the overall contrast characteristic is attainable by electrical compensation of the amplitude characteristics of the system.

By this means, toe and shoulder curvature in the response of the photographic emulsions may be straightened and better overall characteristics obtained than can be obtained by normal photographic methods.

Special reproducing cathode-ray tubes, which, in addition to high powers of resolution, possess screens specially designed to minimise diffusion of light, have been developed for this process.

Such tubes can reproduce contrast even in fine detail, of the order, several hundred to one, so that the authors foresee no difficulty in realising a range of contrast in excess of that which the film will accept, at the same time retaining a linear gradation of tone throughout the range.

The use of the electronic system is, moreover, so completely susceptible to accurate monitoring and control, and the photographic process used is so entirely independent of studio illumination, that the authors are confident that absolute consistency of results can be obtained.

### Conclusion

The authors believe that in the development of this process and recognising the possibility of its ultimate application to colour, they will be placing in the hands of the film industry a new and extremely flexible tool, the use of which should, in their opinion, materially assist in increasing the rate of production and in lowering costs.

It will be appreciated that, at the present early stage of development, it has not been possible for them to submit an intensive

survey of the whole project in precise scientific terms, but in view of the great

interest which has been shown, they have felt that an interim report would be well received.

## DISCUSSION

Mr. R. H. CRICKS : Can high-definition film technique give us colour ?

THE AUTHOR : We are working on a three-part schedule, in which colour is placed second, because the basic work in colour will depend upon the work to be done on black and white.

Mr. D. BIRT : One of the main things about film production is that two basic points of view can be taken from the camera set-up. One is the impersonal outside eye, the other is the personal eye of one of the characters in the story. It is the cutting between the subjective and the objective which makes the film totally different from a stage play or from television. This is impossible in TV; because of the use of multiple cameras you cannot have a reverse angle. One of the most important things in film production is lost at once if TV technique is used.

THE AUTHOR : I should like to make two points. The first is that I have described a production at its very simplest, but there is no reason why cutting cannot be introduced with this method. The prime advantage is that you are not left guessing what the effect will be, but may see the effect of it on a screen. Therefore, the effect you describe is perfectly obtainable in a film produced by electronic methods, precisely as it would be in a film produced by optical methods.

I should not have thought that the number of occasions where reverse angles are used in a normal film would slow up the production time very appreciably.

Mr. D. BIRT : The use of multiple cameras is nothing new in the industry, but has been done at intervals and has always been abandoned for the reason that you cannot light effectively more than one camera position at a time. This is not a matter of intensity of light but of the actual lighting of the subject. You cannot make someone look good from two widely different angles at the same time. You said you did not want to make cheaper films if they were to be "cheap and nasty," and that any drop in quality is a retrograde step. The thing which takes time in film production and makes the visual quality of film so much higher than TV is that each individual set is lit independently, and multiple cameras must give less well-lit pictures.

THE AUTHOR : With the electronic camera it will be possible to achieve, on long sequence shots, successful lighting which would have been quite impossible with normal film technique.

I believe that a perfectionism has entered into film making that is discernible only to the technically minded. I have seen every possible effect of bad lighting in certain continental films and have said,

"That was an excellent picture." I have, on the other hand, come away from the latest Hollywood picture, in which the lighting has been perfect, but audience appeal has not been so good as on the badly lit continental film. I do not think that *everything* depends upon this perfectionism of lighting.

Mr. D. BIRT : Surely we can get speed of production simply by dropping perfection with our existing methods.

THE AUTHOR : You can get additional speed, but not so much; nor would the result be as near perfect as I believe the electronic method can achieve.

Mr. D. BIRT : I was a cutter for fifteen years, but as a director, although obviously I have control over my cutting, I would not like to cut my own picture. The director aims at a specific visual effect and looks for it on the screen and he therefore sees it, but an impartial person, looking at the screen, may not see it. Quite often there may be some small thing, such as a burning cigarette, which is tremendously important to the director, which an ordinary person in the audience will not see, but the director will cut for it. A cutter, who is at the same time a critic, may achieve it in a quite ordinary manner with the material. This may only be apparent some time after you have begun to look at the completed picture. It is only by having some extra material to play with that you can put it right. Is it not your opinion that this business, of having recorded only the material that you actually want may be a danger in the later stages of making a picture ?

THE AUTHOR : I did emphasise the importance of the multiplication and distribution of the image. The director, no matter how good he is, may not see everything completely satisfactorily. The present day cutter, doing his work away from the set, may, with this new technique, sit beside the director and what he is commenting on will exist as an image he can look at and as many people as necessary can see it.

A VISITOR : There are two points about multiple cameras :

- (1) If an artist is playing a scene in full length, he does not play it the same way as for a head shot. He cannot be correct for two cameras at the same time.
- (2) The difference between the close shot and the long shot is not just a matter of moving the camera. You have to recompose the shot to get the best possible pictorial effect.

THE AUTHOR : The product of multiple cameras can be awful with a bad director. I believe it can



be avoided in a number of ways. You will find sections where you are reverting to cutting and editorial work. I do not believe that they are very frequent, and I am sure that there is a "half-way house."

A VISITOR : It has been said that the art of the kinema is the art of cheating. Any attempt to take scenes at great length has the tendency to slow down the tempo of the whole thing, where normally by cutting you eliminate all unnecessary matter—the audience accepts the cutting. If you have a continuous process you are going to get the action slowed down. The value of cutting in film-making is two-fold—it is a dramatic device and is invaluable for eliminating superfluous matter.

THE AUTHOR : I will accept that with two qualifications. If it is an orthodox stage play which is being transferred to the screen, then this slowing up would take place. But with scripts specially written for the films, there is no slowing up. The speed of cutting can be quite as great in an electronic production as in a normally produced film.

Some time ago Sir Alexander Korda and I broke down the TV production of a play, and compared the length of individual shots in the film version with the length of individual shots in the TV production. We found that the TV used far fewer shots. The tempo was much more rapid in the film. We then compared it with another script specially written for television and we found that, because it had been written for a particular subject which required quick cutting, it was as near as possible to normal film production. The cutting was done in the production at the time. Using also inserts of film which had already been taken, I do not believe there is any necessity for tempo to be any slower at all with an electronic production.

Mr. S. C. PEARSON : If you are using electronic cameras, what happens to trick work, such as foreground miniatures, back projection and split-beam shots ?

THE AUTHOR : You can do all the mixing you want. The electronic travelling matte is in a late stage of development. In point of fact, the third item in our development programme is the adaptation for every form of process shot.

There are some films where the electronic camera can be used more than usual. In other films only a few interiors may be taken with this method, the rest having been taken by optical cameras on location. The director decides how complicated he wants to make the production in terms of the electronic or optical camera.

A MEMBER : I should like to ask whether it is fundamental to this new technique when working in a studio, to use not less than two cameras. If it is physically impossible to utilise two cameras, what is the advantage in not using an optical camera ?

THE AUTHOR : I should have thought on these

occasions, when you are driven by the design of the set to use a single camera, there is everything in favour of an optical camera.

A VISITOR : I should have thought the main advantage of using an electronic single camera was that the director, for the first time in his life, can see what goes on in the camera.

Mr. H. WAXMAN : The electronic camera cuts out the time-lag before we see the rushes. That, in itself, may be a good thing, if there is any doubt about what the results will be like. The main time factor to-day, is the time taken in lighting, because it is the only thing you cannot prepare in advance.

THE AUTHOR : The question of the time waiting for the rushes is so trivial as to be unimportant. The basic factor is that the director can see what he is achieving at the time of shooting.

A VISITOR : Can the industry afford this luxury ?

THE AUTHOR : I do not regard it as a luxury. At the moment it is very good if  $2\frac{1}{2}$  minutes of film a day is shot. With the electronic method 10 minutes a day can be taken. Production time is reduced from 12 or 14 weeks to 3 or 4 weeks. This will render economic the production of certain types of films at present out of the question. There is a large number of stages in this country which can be brought back into employment with productions which will satisfy the public and which will cost less than at present. I do not believe there is any way of restoring the industry unless basic costs can be reduced. I do not think this is possible with normal production methods.

Dr. GEDDES : When independent frame started many people said that it was useless, others that it would solve every problem. In the outcome we have got a lot of very good equipment. I would suggest here, that instead of expecting to produce a 20-week film in 5 weeks we should say 15 weeks, and even then we will be better off.

A VISITOR : What is going to happen to our construction schedule, when the shooting schedule is cut to about four weeks ? Will we have to build more stages ?

THE AUTHOR : No. One of the things which impresses those familiar with both television production and film production is the totally different layout of the studio. Many television sets are constructed around the wall of the existing studio, without interfering in any way with what is going on in the set. One of the changes we shall notice is the completely different lay-out of sets for electronic technique which will resemble more nearly the sets of a television studio. I was looking at the sets of the film recently shot by electronic methods at Elstree. The set is a composite one and is midway, I should say, between what is customary in television and what is customary in a normal film production.

The floors in film studios will have to be cleaned and nails removed in order that cameras may be tracked in any direction,



A MEMBER : To get ten minutes in the can each day will require a large number of sets. Could you do this on two stages ?

THE AUTHOR : You will have to qualify the type of film you are making. I find myself dividing up films I see into several categories. In the first I say "the whole of this could have been accomplished by electronic methods." In the second, I say "this would have been rather a slow job." At the bottom of this category I find films which I should not have liked to have attempted at all.

There is a very large number of films which could have been shot at the speed I am describing without any member of the audience saying "That was a very good photographed play."

MR. E. L. PHILLIPS : Are your cameras going to be so much more sensitive that your lighting problems will be lessened by the need for less light ?

THE AUTHOR : That is so.

MR. E. L. PHILLIPS : There does arise this very important point of depth of focus. In television it is very small. Are you hoping to overcome that ?

THE AUTHOR : The latest television cameras do not give that effect, and the cameras with which we are proposing to work will certainly not give that effect.

MR. W. S. BLAND : As you are approaching television technique, I feel you must get television restrictions as far as your sets are concerned. Therefore one is going to lose one of the main assets of the kinema, which is big scenes. Another point is that the cameraman would not be able to do the dramatic lighting effects possible at present.

On the question of sound. Whilst you are trying to shoot four angles your microphone must be out of range on the longest shots. This will possibly make things awkward.

MR. A. C. SNOWDEN : Have you any idea of what the normal re-equipment of a stage sufficient to handle the production of a normal feature film would cost.

THE AUTHOR : The electronic industry is in a state of very rapid development and rather than see every studio re-equipped at this moment with gear which may soon become out of date, the thing to do is to prepare the gear in a transportable form so that it can be taken to the studios for the purpose of making specific films.

DR. F. S. HAWKINS : What intensity of light is required. One gathers the impression that some electronic cameras are quite sensitive devices, and so work with very few foot candles, far fewer than the cameras for black-and-white photography in the

studios today. Shall we have to revise our lighting fittings to give far less light ?

A point of some considerable interest is the use of multiple cameras and it is perhaps interesting to note that in a recent issue of *American Cinematographer* there was a description of how films are made for television, not using the electronic camera. It is stated that they used more than one camera at a time, saving both time and money, but when asked what results were obtained, the answer was given that they were only for reproduction over the television system !

However many foot candles you use, your light and shade is relatively the same and therefore the objections which have been raised to the use of multiple cameras will still be valid. It is quite clear that not every shot requires more elaborate form of lighting ?

THE AUTHOR : There are electronic cameras which will give a picture with the light of a cigarette. The quality is not very good. There are others which require lighting approaching that of a black-and-white film. I suppose the answer is somewhere in between. A figure of 80 foot candles incident on the scene is something of the order which we have used with the camera.

The process we are advocating gives the opportunity to preview and see what sort of picture you are getting from each camera before you use it. So if the effect is not good, it is not used. On the question of flatness of lighting, it is quite correct that the light to darkness ratios are not affected by the amount of light which falls on them, but the response of the electronic camera can be shaped or distorted so as to increase or decrease that contrast range. I believe you would get away with more than is supposed.

MR. R. L. HOULT : Feature film production in colour may soon be more than 50 per cent. of all films produced. If this is so, any specially-designed receiving equipment should work equally well with colour as with black-and-white. You will have the problem of either separating scenes into their primary colours, recombining them on an integral colour tube and photographing them with a conventional camera ; or splitting up the image optically and photographing the three primaries on to three black-and-white tubes as separation negatives.

I think it well worth while to commence investigation into this problem at the outset, to make sure it does not lag far behind.

THE AUTHOR : I think probably the easiest way would be to photograph the three black-and-white images. I do not think that colour is as big a difficulty as one might think.

## A NEW TELEVISION RECORDING CAMERA

W. D. Kemp, B.Sc., A.M.I.E.E. \*

*Read to a joint meeting of the British Kinematograph Society and the Television Society on April 2, 1952.*

TELEVISION systems designed for broadcasting have very short intervals between successive pictures in order to economise on bandwidth. The present intervals used by the British Broadcasting Corporation are about 1.4 milliseconds, which represents about  $12^\circ$  if the complete picture period is taken as  $360^\circ$ . At present it has not been found practicable to advance the film in such a short period.

To overcome this difficulty the first B.B.C. system of television recording used continuous motion.<sup>1</sup> A new version of the original equipment is shortly to be installed at the Lime Grove Television Studios.<sup>2</sup> These equipments use 35 mm. film, and the running cost is high (about £120 an hour). With the growth of recording here and in America cheaper methods became desirable, and development was concentrated on 16 mm.

Continuous motion recording did not seem attractive in the case of 16 mm. film for the following reasons :—

- (a) The velocity stability required to obtain correct interlacing would be higher than that necessary for 35 mm., because of the smaller line pitch.
- (b) The linear velocity of the film is under half that of 35 mm., and this renders stabilization more difficult.
- (c) There is only one sprocket hole per frame in 16 mm. film and thus the sprocket hole flutter frequency is 25 cycles. Flutter at this frequency is particularly liable to cause bad interlacing.
- (d) The small size of the film necessitates a halving of mechanical tolerances generally for equivalent results.
- (e) No continuous motion mechanism had been developed for 16 mm. film which gives the required performance.

For the above reasons possible intermittent methods were considered.

### Some Intermittent Methods of Television Recording

Fig. 1 illustrates some exposure sequences which give more time than the interval between television pictures for advancing the film. The film camera must be phase locked to the television signals. It will be realised that any such exposure sequence must lose information of some sort, and although each sequence gives an interlaced picture of the full number of lines on each film frame this is only done by repeating some television lines on successive frames of the film.

#### (i) 16 2/3 Method<sup>3</sup>

The period is three television scans, two of which are recorded, the third being lost while the film is advanced one frame. The pull down required is thus  $120^\circ$  of the cycle. Since for every three complete television pictures only two film frames are produced, the film must run at 16 2/3 f.p.s. It is possible to step print the negative to obtain a 25 f.p.s. film by repeating every other frame.

#### (ii) Step Printing in the Camera

The step printing process can be done in the camera itself by the use of a double optical system, and a film traction mechanism which advances the film alternatively one frame and then two frames.

With the phasing shown in Fig. 1, for instance, television picture 1 (scans 1 and 2) is recorded in both top and bottom apertures of the double gate, and then the film is advanced two frames during scan 3 after which scans 4 and 5 are recorded in the top aperture. The film is then advanced one frame which leaves two unexposed frames in the gate for the cycle to repeat. In the period of 3 complete television pictures, three film frames are produced, and therefore the

\* Late B.B.C. Planning and Installation Department, now with High-Definition Films, Ltd.

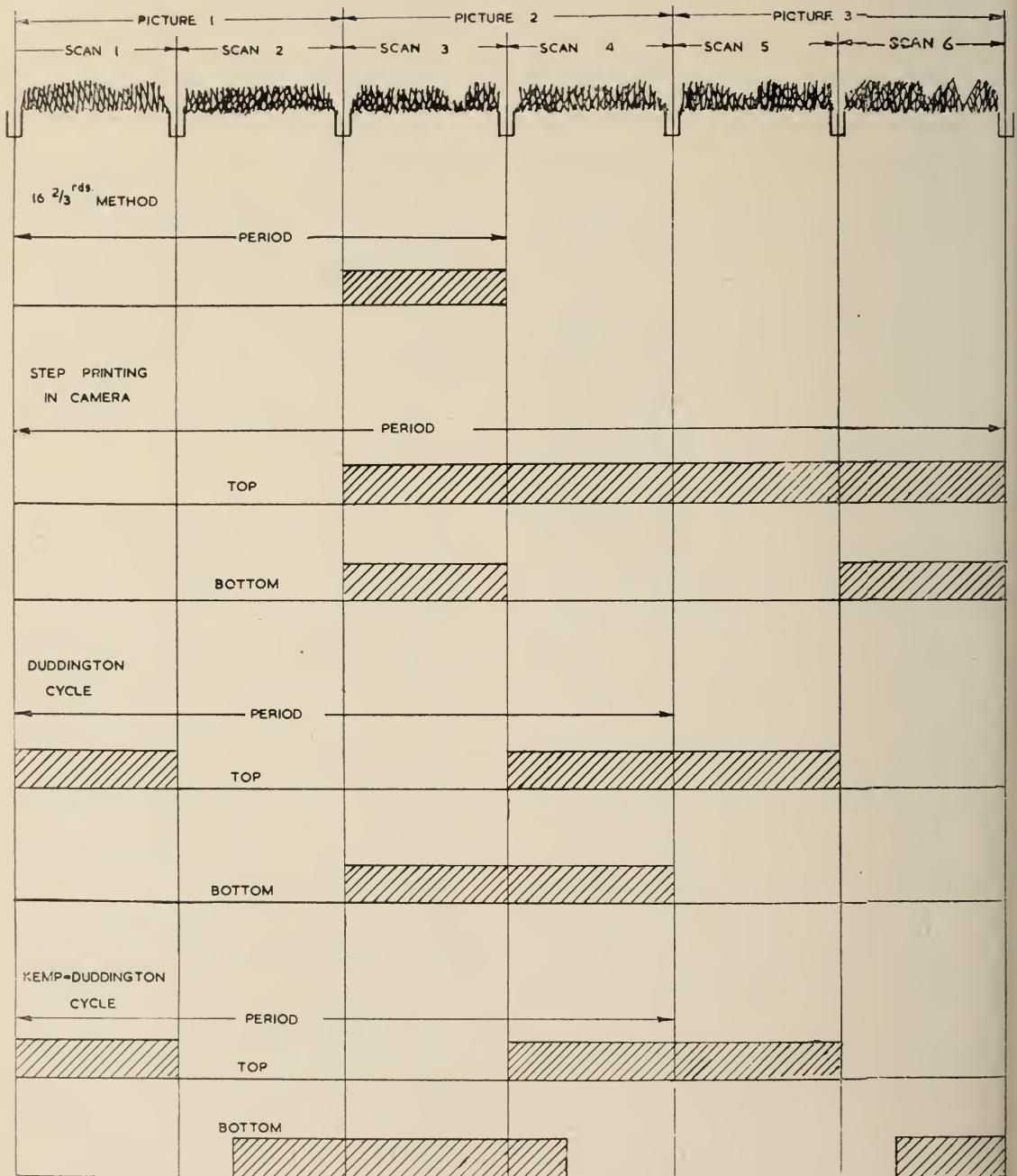
EXPOSURE SEQUENCES

Fig. 1.



film speed is 25 f.p.s. The pull down required is  $120^\circ$  of the period between pull downs.

(iii) *Duddington Cycle*<sup>4</sup>

In this system only one scan instead of a complete television picture is repeated. A double optical system and gate is required as before.

Television picture 1 (scans 1 and 2) is recorded in the bottom aperture, and scans 2 and 3 in the top aperture. Scan 4 is lost, and the film is advanced two frames in this period. The cycle then repeats. The pull down required is  $90^\circ$  of the cycle. As two film frames are recorded in the period of two television pictures the camera runs at 25 f.p.s.

(iv) *Kemp-Duddington Cycle*<sup>4</sup>

The effect of the Duddington cycle is to take film frames at unequal time intervals, and this tends to produce some jerkiness of movement on fast moving objects in the picture. The effect can be reduced by using a similar cycle but with the phasing between the two pictures altered to give more equal time intervals between the exposure of consecutive film frames. In this case there is less time available for pull down of the film, and a "picture join" is necessary.

The camera described in this paper was designed to work on the Duddington cycle, with a view to modifying it to work on the Kemp-Duddington cycle should jerkiness of movement prove objectionable. In practice it was found that normal movements are photographed satisfactorily, and therefore the modifications were not carried out.

It is interesting to note that the Kemp-Duddington cycle represents the general case of exposure sequence in a double gate camera. As the time intervals of exposure become more nearly equal the time available for pull down decreases until in the limit pull down must occur in the period between television pictures.

### Construction of the Camera

Any motion picture and sound camera consists basically of the following units :—

- (a) Optical system
- (b) Shutters
- (c) Film transporting mechanism

- (d) Viewfinder
- (e) Driving motor
- (f) Film magazine
- (g) Sound system.

A camera designed for photographing a television picture needs an additional unit for phasing the camera mechanism to the television signals and any camera which has a double gate must have means for achieving accurate positioning of the images in each gate. This has been called "optical registration."

The above units of the television recording camera will now be described with particular reference to the differences from a normal motion-picture camera.

(i) *Optical System*

This is required to produce two images, identical in size, shape and brightness, located one above the other in the double gate aperture, at the normal 16 mm. frame spacing. The resolution should be as good as that obtainable from a single lens.

The optical system used is shown in Fig. 2. It was designed by Dr. H. Hopkins. Light from the television picture at O falls on the prism P and after being rendered parallel by the lens combination  $L_1$  is partially reflected from the mirror  $M_1$ . The light which is not reflected passes through  $M_1$  and is reflected from  $M_2$ .  $M_1$  and  $M_2$  are inclined at very small angles to the  $45^\circ$  line, and therefore two images are formed by the main lens  $L_2$ . The vertical spacing between the images can be varied by varying the angle of  $M_1$  and  $M_2$ , and by rotating the mount of  $M_1$  relative to that of  $M_2$  the sideways positioning can be changed.

The light reflected from the semi-silvered mirror M comes partly from the upper air/glass surface and partly from the lower air/glass surface, although only one of these is silvered. The purpose of collimating the light falling on  $M_1$  is to ensure that the rays from both surfaces are parallel. If this is so the image produced by each ray will superimpose on the film, and so no double image will be formed. It is important that the mirror surfaces should be accurately parallel to achieve this result.

The mirror  $M_1$  must reflect just the correct percentage of light to make each image the same brightness. This is about 39 per cent of the incident light, and therefore at full aperture (F1.9) the effective aperture is about F3.0.

### (ii) Optical Registration

It is necessary to position the two images so that they are in exactly the correct relation with the sprocket holes on the film. This is achieved by using the camera as a projector in the following manner:

A film of a resolution chart is made by normal means, and a loop of this is threaded in the camera. Behind the camera gate is a prism, used for the "through the film" viewfinder. A normal condenser and lamp is used

able to make the film for setting up with the camera itself.

This can be done by achieving approximate alignment by the method above, and then photographing a transparent test chart held in the position formerly occupied by the cathode-ray tube screen. It is convenient to use the cathode-ray tube as the light source for this purpose. After development the film is loaded in the camera and the image projected on the face of the cathode-ray tube. If the film is loaded in the same position it occupied when being exposed then perfect superimposition will be obtained independently of the accuracy of optical alignment. If, however, it is displaced one frame, then alignment errors will be doubled. By making

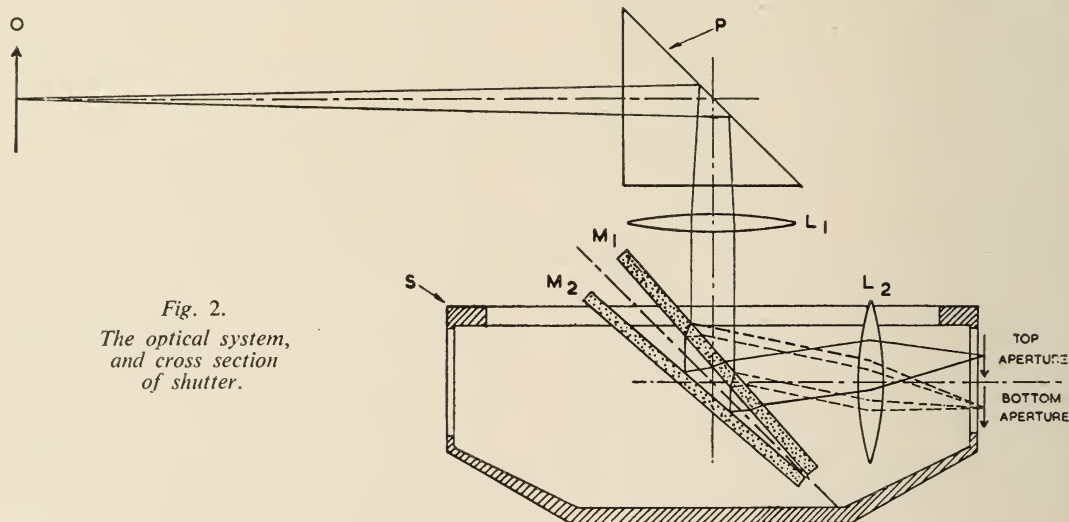


Fig. 2.  
The optical system,  
and cross section  
of shutter.

to illuminate the film through this prism, so that an image is formed on the cathode ray tube. If the mechanism is turned so that the shutter reveals both top and bottom apertures, a double image is formed, and it is relatively easy to adjust the mirrors so that superimposition is achieved.

It is important that the film used for achieving optical registration is of very high definition and free from "bounce." The sprocket holes must also be undamaged, and the film should be of the same physical dimensions as the raw stock it is proposed to use. Since it is difficult to obtain 16 mm. films which meet these conditions it is desir-

able to make the film for setting up with the camera itself. This can be done by achieving approximate alignment by the method above, and then photographing a transparent test chart held in the position formerly occupied by the cathode-ray tube screen. It is convenient to use the cathode-ray tube as the light source for this purpose. After development the film is loaded in the camera and the image projected on the face of the cathode-ray tube. If the film is loaded in the same position it occupied when being exposed then perfect superimposition will be obtained independently of the accuracy of optical alignment. If, however, it is displaced one frame, then alignment errors will be doubled. By making

a loop of the film containing an odd number of frames it is possible to see both conditions one after another when the camera is running. The optical system is then adjusted to produce equal errors under both conditions. A further advantage of running the camera is that perforation tolerances then tend to be averaged. It has been found that if raw stock is exposed and hand processed immediately the shrinkage is negligible, although as the film dries out it may become intolerable.

The above alignment procedure enables substantially perfect alignment to be obtained, and the frame to frame position-errors are

smaller than in most normal 16 mm. film cameras.

The optical resolution is satisfactory, it being possible to resolve 1,000 picture elements per picture width in all parts of the field of both frames. The resolving power in the upper frame tends to be better than that in the lower, presumably because of the difficulty of obtaining perfectly parallel glass for the semi-silvered mirror.

A defect exists in the optical system in its present form in that a very small "keystone" distortion occurs on both upper and lower images. This has the effect of making the picture too wide at the top of the upper image, and at the bottom of the lower image.

and bottom of the picture at full aperture due to lack of depth of focus in the film plane. Other methods are being investigated.

### (iii) Shutter

The shutter (S, Fig. 2 and Fig. 3) performs the following functions :

- (a) It must obscure each image in turn, and both images during the pull down period. Ideally there should be no "spill-over" of light from the illuminated part of the film to the unilluminated part during the first part of the cycle.
  - (b) The obscuring action should take place in the intervals between television scans.
- With the optical system described there is

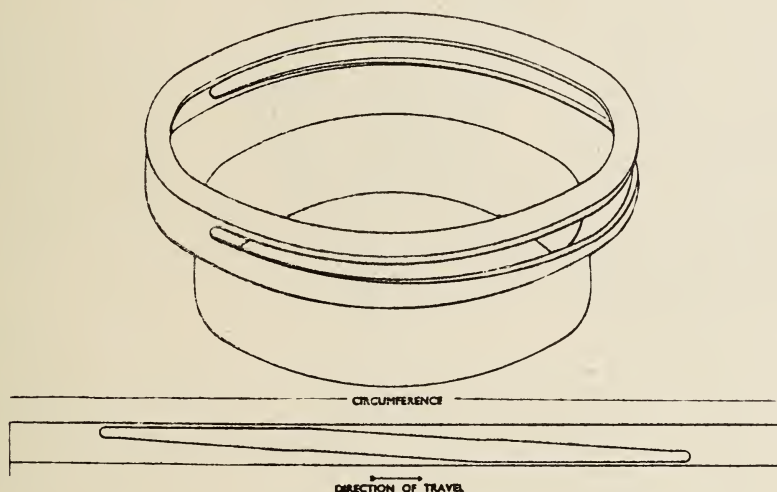


Fig. 3. The Shutter.

The distortion, therefore, occurs at the top and bottom on alternate frames, and this is noticeable as a cyclic "jump" in these parts of the picture on projection. The amplitude of the jump is small, being only a few picture elements, but it is objectionable when a static object, sharply in focus, happens to appear in either of these two positions.

There are several ways of reducing the keystone effect to negligible proportions. One way would be to incline the two halves of the gate at a slight angle (equal to that of the mirrors). The film would fit such a gate satisfactorily because of the lifting action during pull down. A disadvantage of this method would be some defocussing at top

only one position where two images exist in space, i.e. the film gate itself. The shutter must, therefore, be of the focal plane type. As the shutter cannot be in contact with the film, and as in practice there is about 1/10th of an inch clearance, some spill-over must exist. If the spill-over is exactly equal on both frames it tends to cancel out, since the under-exposure produced at the bottom of the top frame due to partial obscuration of the lens by the shutter, is somewhat compensated for by spilled light from the bottom frame when this is exposed. The same argument applies to the bottom frame.

In practice the spill-over is not equal as mechanical tolerances cause slight variation





Fig. 4.

16 mm. T.V. Recording Camera.

afterglow over the full exposure time cannot be neglected. Indeed there is evidence to show that it contributes up to 25 per cent of the exposure. It is therefore important to give an equal exposure time to all particles of the emulsion, and this is the reason for the shape of slot shown in Fig. 3.

At the end of the cycle the full exposure time for afterglow cannot be allowed and the exposure is therefore reduced for the last few lines in the picture unless the pull down time is shortened. It would seem desirable to use a cathode-ray tube phosphor of shorter decay to make this effect completely negligible.

of the position of the shutter edge. The first shutter employed produced flicker at the top and bottom of the frame for this reason.

To avoid this flicker it was decided to use the movement of the spot on the screen to obscure the image. This can be done by making a shutter which has a helical slot cut in it for each image. As the shutter rotates, the projection of the slot moves on the film in a vertical direction so that the spot of light from the television picture which is recording the image is in its centre. When the spot of light moves from bottom to top of the cathode ray tube during the television frame suppression period the image falls outside the slot and is so cut off. Unfortunately it was not mechanically possible to cut a double slot in the shutter and so a single slot of variable width was used. This is shown in Fig. 3.

Although the phosphor used on the cathode-ray tube (zinc sulphide) has a short decay, it is found that the integrated effect of

#### (iv) *Film Transporting Mechanism*

In any double gated camera great accuracy of film registration is required since errors do not repeat on successive frames. For this reason it was decided to use a shuttle gate which has fixed register pins, and is known to provide great accuracy of registration. A further advantage of the shuttle gate is the lack of friction on the film during pull down, since it is then held loosely in the film guide. This low gate friction prevents "emulsion pile up," which has been found to be serious on recording cameras as they are expected to run for long periods without cleaning.

Two register pins are used. For silent film both are between the two frames in the gate, the one on the sprocket hole side being full fitting and the other fitting top and bottom only. For sound film the full fitting pin is between the frames, and a side fitting pin is put in the upper frame. Interchangeable

aperture plates with sound and silent register pins are provided.

Tests showed that the gate stability was best when the silent aperture plate was used. With sound film variations in registration tended to occur on the side remote from the register pins.

The 90° pull down required was obtained by driving the triangular cam mechanism used with a shuttle gate at twice the normal speed and utilizing every other stroke only. This gives a pull down in 60°, and leaves 15° each side of pull down for moving the shuttle gate.

(v) *Viewfinder*

This of the "through the film" type, using a prism behind the gate. As mentioned earlier, it is possible to illuminate the gate by this prism so that the camera can be used as a projector. While recording the viewfinder is seldom used as once camera and cathode-ray tube have been aligned relative movement is unlikely to occur. Even the initial alignment is usually done by projecting the gate aperture on to the cathode-ray tube.

(vi) *Driving Motor*

This is a 4-pole 1500 v.p.m. synchronous motor coupled directly to the triangular cam shaft so that the rotor acts as a flywheel. The stator is rotatable through 270° to adjust the relative phasing with the television signals.

(vii) *Phasing Indicator*

A disc with one witness mark on its circumference is mounted on a motor-shaft. This is illuminated by a neon lamp (see Figs. 4 & 5) which is driven from the television frame synchronising pulses in such a way that one flash occurs at the start of every frame sup-

pression period. The duration of the flash is so short that movement of the witness mark is arrested, and the position of the motor at the commencement of the frame suppression period indicated.

(viii) *Film Magazine*

This is a 16 mm. version of a standard 35 mm. magazine. The film capacity is 1,000 feet, and the light traps are of the three roller type. The take up is by friction disc and direct gear drive, as trouble has been experienced with the more usual belt drive.

(ix) *Sound System*

This was of the variable area type, using noise reduction, and was provided by RCA Photophone Ltd. The question of sound recording for 16 mm. is still under consideration, and it may be that ultimately synchronised magnetic tape will be employed. This has the advantage of providing a high quality master from which 16 mm. married prints can be made by re-recording, thus eliminating the printer losses.

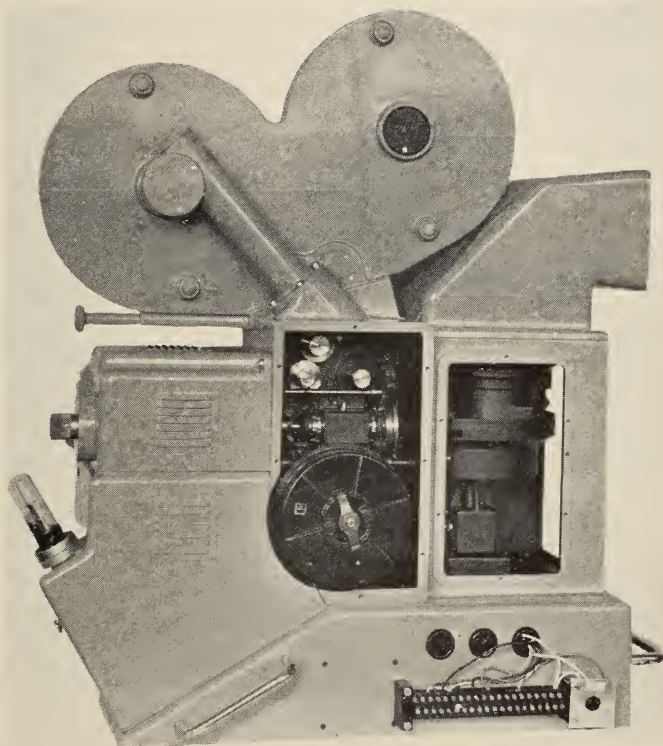


Fig. 5.  
16 mm. T.V. Recording Camera  
(reverse view).



## Conclusions

The intermittent system employed is a satisfactory method of recording television signals which have very short intervals between television pictures.

Excellent interlacing can be achieved with good general definition. Movement is satisfactory, although jerkiness can be detected, particularly on camera pans.

Further work remains to be done to improve the optical system geometry.

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3. Smith, D. A. Television Recording, *Wireless World*, 55, 305.
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## DISCUSSION

MR. R. H. CRICKS : Why cannot the "flying spot" system, as used in the Telecine film transmission apparatus be used for recording ?

THE AUTHOR : I suppose the principal reason against that is the afterglow on the C.R. tube. In the 35 mm. film scanners at Alexandra Palace there is relative movement between the raster and the film. If there is afterglow, white objects tend to smear in the vertical direction. That is one of the difficulties, but I am not saying that it is unsurmountable.

A VISITOR : I wonder whether the author would indicate the order of the time of desirable afterglow. Would it be equal to or less than one line period ?

THE AUTHOR : I think very much more than one line period would be acceptable. It should be down to 1/100 of its value in a few lines.

MR. S. N. DOHERTY : The horizontal resolution of a telefilm does seem to be somewhat below that of ordinary film from Alexandra Palace. Would you say that the loss was in the optical system or in the actual television tube with which the picture is recorded ?

THE AUTHOR : It is true that in photographing television you do seem to lose definition. It is a very big subject, and there are a number of things which cause loss, such as :

- (1) The Electron beam scanning over the phosphor, which is losing something by dispersion in the phosphor ; and
- (2) an imperfect optical system.

In these double optical systems you tend to get lower resolution. You could not resolve a 400 line raster on 16 mm. Plus X. We know there are very fine grain stocks, but when this film was shot we hadn't light to expose on them. Theoretically it is quite possible to produce television recordings which are identical with the original.

DR. F. S. HAWKINS : If you were to photograph two cathode-ray tubes, each showing a half of the interlaced scan instead of photographing the same tube twice to secure the complete scan, would this produce other difficulties which are even worse ?

THE AUTHOR : I am afraid it would. It would be very difficult to get television tubes with linearity accurate enough to superimpose them.

MR. R. L. HOULT : The reflecting shutter which you showed in the diagram (Fig. 2) was, I take it, included in the Moy camera. I would have thought that the form of shutter would give some relative keystoneing between the two images owing to the different angles of the two mirrors. Is that so ?

THE AUTHOR : The keystoneing which came out is undoubtedly due to the mirrors. The focal length of the second lens was chosen at 75 mm., which is very long for 16 mm. film, entirely to make the keystoneing negligible.

MR. B. J. STOCKS : Was any spot wobble used in the system by which these films were recorded ?

THE AUTHOR : No.

MR. B. HONRI : Is the two frame pull-down related to interlacing ? If you had sequential scanning would it be necessary ?

THE AUTHOR : The camera was designed around the transmission standards of the B.B.C., and it only works on interlace signals. The whole reason for making this rather specialised camera was to try and record television standards as radiated. If you can make your television standards anything you like, this kind of camera has no application at all.

MR. LUCAS : Does the shutter cause any air turbulence, which will throw dust onto the lower surfaces ?

THE AUTHOR : No. The main lens comes in front of the reflecting surfaces, and is situated with the optical system in a metal housing, which is practically airtight.



## TELEVISION FILMING

V. E. Hughes\*

THE association of television with film making is a new application which is proving to be one of the most successful of recent innovations in the world of television. In the film industry it is also being followed up enthusiastically for, not only does it mean a great saving in time and money during the making of films in studios, but it also allows on-the-spot events to be filmed and then projected on to a kinema screen with only ninety second time lag, at the same time providing permanent record on film. Unlimited prints may be taken from the negative version of such a record for wider distribution.

For the past few months this system has been used at the Palais de Chaillot, in Paris, during the deliberations of the United Nations Organization, and it has enabled a completely edited film to be shown over the B.B.C. television system the same evening of the day the events took place. These films have also been shown on the New York systems the morning after.

In Paris the three-camera television unit was installed and operated by engineers of Marconi's Wireless Telegraph Co., Ltd., while Paramount Pictures Corporation provided the Theatre Television (or Kinescope) unit which takes the television pictures from a master monitor and films them.

### Television v. Film Technique

To appreciate fully the great value of this merger the fundamental differences between film and television production must be considered. Of major importance in film making is the sequence when a mass of celluloid must be sorted, foot by foot, arranged into a sequence giving perfect continuity, and cut and spliced to give the finished product. Apart from the high labour cost, there is the added cost of the waste film which can easily be twenty or thirty times the amount contained in the finished picture.

Scenes are shot many times over and sometimes angles are altered and camera positions moved after scenes have been shot necessitating more film, more time, and more editing.

Television production, on the other hand, is instantaneous. The producer uses more than one camera at a time—three is the usual number—and he is presented with a picture from each at his production point. Each camera is equipped with three or four lenses (at the Palais de Chaillot, four lenses) and there is therefore a choice of twelve different "takes." The three cameras will usually be in different positions, at different angles, and at different elevations.

This combination provides the producer with a wide choice of final picture.

In practice the major "plot" for shooting is drawn up beforehand and during transmission the producer instructs two of the cameramen which angle, position (if they are on dollies) and lens to use next, while accepting a picture from the third. The facility and rapidity with which twelve lenses, three cameras, three positions and three angles can be varied and used makes for smooth and fluid continuity.

### Combined Film and Television Technique

The new technique, then, is the fusion of television production with the permanency of films, the slightly inferior definition of the television picture being offset by the enormous saving in time, labour, and cost.

In Paris the complete organization started with three television cameras strategically placed in the Chamber in use and their respective cables led to the television control room. In this control room the camera control operators, engineers, and producer took the three transmissions. Following normal television practice the producer used his cameras to give a completely edited programme, the master picture of which was reproduced on an eight inch cathode-ray

Reprinted from *Electronic Engineering*, July, 1952, by courtesy of the Editor.

\* Marconi's Wireless Telegraph Co., Ltd.

tube. A few inches from this tube was the film camera and its associated sound head, sound being brought through from microphones in the Chamber in the normal television manner.

The camera records both vision and sound on 35 mm. film (16 mm. can be used) and the Kinescope process starts. From the camera the film passes through a series of tanks which completely process it. At the end of the process, which includes drying, the film goes through a projector for monitoring purposes, and is then wound to its final reel (see Fig. 1).

Only ninety seconds elapse from the time a frame passes before the cathode-ray tube until it is wound on the reel.

The equipment is made up of three basic units. First there is the high definition television monitor capable of displaying a positive or negative picture on the cathode-ray tube. This change is achieved by simple reversal of polarity. The unit includes an electronic shutter as an integral part to allow the 30 frame (in Britain it would be 25 frame) television signal to synchronize, or resolve, to the motion picture rate of 24 frames per second.

This monitor can, of course, be adjusted to receive any television standard of line and frequency. The circuits are designed for a bandwidth of 10 megacycles but can easily be adapted to take higher definition standards. The function of the electronic shutter is to blank out the cathode-ray tube at appropriate intervals in order to synchronize with the pull-down of the shutterless movie camera; it is completely automatic and assures one complete television frame being exposed on one film frame. The polarity of the picture (positive or negative) is controlled by one switch while simple controls adjust for non-linearity of incoming signals, for brightness and contrast.

The second unit is the shutterless cameras

and its associated film magazine which contains 12,000 feet of film. It also incorporates a newly designed sound-on-film recorder which has no moving parts. The 12,000 feet of film will give continuous recording for over two hours. The sound track is a variable density type and sound fidelity is limited only by the reproduction system in a theatre. This unit photographs the image on the cathode-ray tube of unit 1, and records the sound passed through the microphones. This produces a completely exposed single-system film.

The third unit is a high-speed processing machine designed to develop, rinse, fix, wash, and dry the exposed film at synchronous sound projector speed of 90 feet per minute, 24 frames per second, using high temperature, high pressure spray

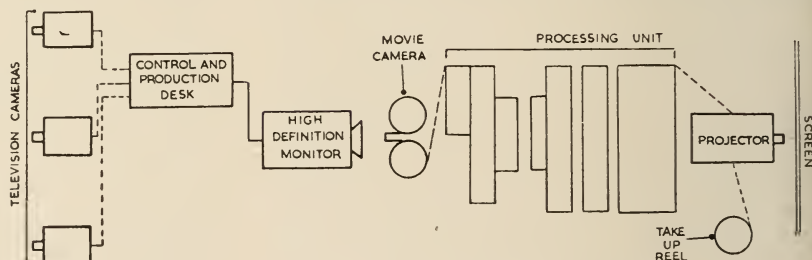


Fig. 1. Layout of the Kinescope.

techniques. Fast drying is accomplished by means of squeegees and hot air and the film quality, using these techniques, is equal to or better than standard release quality. At the end of the processing chain the film can, if required, be passed through a projector for theatre use or monitoring before being wound on its finished reel. The complete process is automatic—one control starts the camera, process machine, theatre or monitor projector, and final wind. All temperatures are thermostatically controlled and all components are interlocked to ensure simultaneous stopping and starting.

The film normally used is standard 35 mm. fine grain and packaged chemicals allow unskilled operators to take charge.

Physically the whole unit takes up 60 square feet of floor space and can be situated (in a theatre) anywhere near to the projectors.

Hot and cold water supplies are needed and a drain for the disposal of surplus water and solutions.

Since this article has been written the major British film companies have been

experimenting with television as an aid to production in the studios and on sound sets, and it seems probable that there will be considerable development in this field in the near future.

## THE COUNCIL

*Summary of the meeting held on Wednesday, July 16, 1952, at 164, Shaftesbury Avenue, W.C.2.*

**Present :** Mr. L. Knopp (*President*) in the Chair, and Messrs. B. Honri (*Vice-President*), H. S. Hind (*Deputy Vice-President*), R. J. T. Brown (*Hon. Secretary*), R. E. Pulman (*Hon. Treasurer*), G. J. Craig, F. S. Hawkins, N. Leever, S. A. Stevens and D. Ward.

**In Attendance :** Miss J. Poynton (*Secretary*).

**Apology for Absence :** An apology for absence was received from the Past President.

**I.S.O. Conference.**—The President, having returned from New York, is preparing his report on the work which was undertaken. It will be published in the October issue of *BRITISH KINEMATOGRAPHY*.

**1953 Convention.**—The *Ad Hoc* Committee has recommended to the Council that a residential Convention shall be arranged during 1953. An opportunity will be given members to indicate their support for the event.

**BRITISH KINEMATOGRAPHY.**—Mr. R. J. T. Brown is appointed the Hon. Technical Editor of the Journal.

Montague Victor Gover (Member), 20 Ewell Downs Road, Ewell, Surrey.

Robert William Southam (Associate), Brent Laboratories, Ltd., North Circular Road, London, N.W.2.

The following is transferred from Associateship to Membership :

Jack Percival Sheppard, United Motion Pictures, Ltd., 24 Denmark Street, London, W.1.

The resignation of one Associate was noted with regret.

*Report received and adopted.*

**Projectionists Apprenticeship Scheme.**—The syllabus for the training of projectionists is submitted to the C.E.A. and the N.A.T.K.E. for approval. A method of examination is now under review.

*Report received and adopted.*

**Education Committee.**—Two Courses of Study will be arranged in the forthcoming session. The first will be on Colour Kinematography, which will commence at Ealing Studios on October 6, 1952, and the second will be on Colour Film Processing and Colour Sensitometry which will commence on January 19, 1953. The details will be circulated in due course.

*Report received and adopted.*

**Television Division.**—The avoidance of any clash in activity with the Television Society is fully safeguarded by cross representation both at Council and Committee level.

*Report received and adopted.*

The proceedings then terminated.

## COMMITTEE REPORTS

**Membership Committee.**—The following are elected :

Fazlur Rahman (Associate), Delco Radio Engineers, 37 Lyall Street, Dacca, East Pakistan.

Reginald Elwick Beatty Hickman (Member), RCA Photophone, Ltd., 34 Woodstock Grove, London, W.12.

Douglas William Digwood (Member), National Theatre Supply Co. of Australasia Pty. Ltd., 251a Pitt Street, Sydney, N.S.W.

## 1952-53 COURSES OF STUDY

Of interest both to studio and laboratory personnel are the two courses of study to take place in the coming session.

A course on Colour Kinematography will commence at Ealing Studios on October 6. Six lectures will be arranged when the student will be instructed in the first principles of colour, the processes in use and the techniques involved in this highly specialised field.

The course on Colour Film Processing and Colour Sensitometry will commence in January, 1953.

The details of the courses and the enrolment forms will be received in due course.

## PERSONAL NEWS OF MEMBERS

*Members are urged to keep their fellow members informed of their activities through the medium of "British Kinematography."*

IR. GEORGE BAKOS has joined Philips Electrical Ltd., at Eindhoven, Holland, as chief development engineer in the ELA—Recording department.

D. FORRESTER, recently returned from a business visit to the Near East, is now in Hollywood.

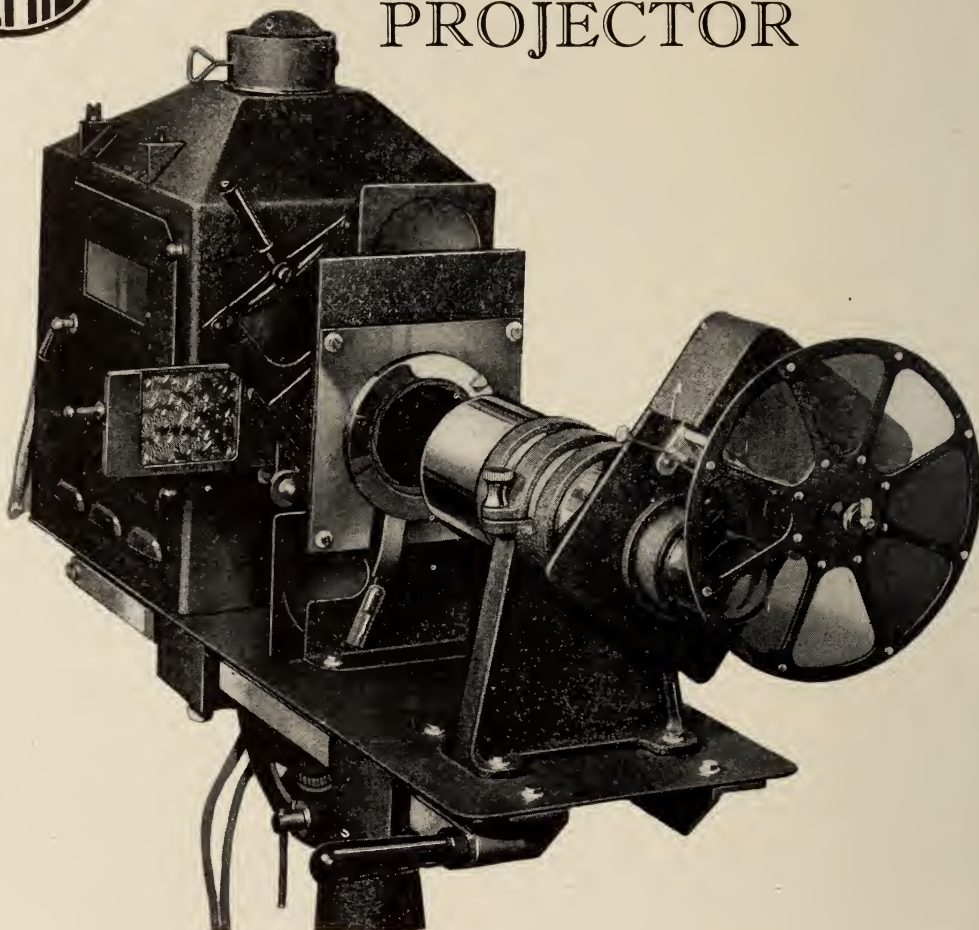
HAROLD KING, recording director for Associated British Pictures, Ltd., is also on a business visit to Hollywood.

STANLEY IRVING has been appointed Films Officer to the Gas Council.





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# BRITISH KINEMATOGRAPHY

VOLUME 21 No. 3

HON. TECHNICAL EDITOR:  
R. J. T. BROWN, D.S.C., B.Sc. (Fellow)

SEPTEMBER, 1952

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## THE LIBRARY

DISTRIBUTED with this issue of the *Journal* is a new edition of the Library catalogue, last printed in 1948. It is hoped the catalogue will prove of value to members for reference, and at the same time serve to remind those who may have forgotten, or others who may not have heard of the Library, that a very useful collection of books and periodicals relating to cinematography and allied subjects is available at the Society's headquarters. Attention is specially directed to the fact that books may be borrowed by post as well as by personal request at the Library.

There are about 150 volumes listed in the catalogue which have been published since the war, and it is claimed, with justification, that the Library is reasonably comprehensive. Nevertheless there is room for improvement, and the extent to which this can be achieved depends largely upon the interest shown by

members in the Library's existence. If the demand is there, facilities, within reason, will be adjusted to meet it.

For example, arrangements are being considered whereby periodicals, other than those immediately current can be loaned in the same manner as books; at present a Library rule precludes this. Further, an agreement with the Royal Photographic Society now enables members of the B.K.S. to borrow volumes from the extensive library of that Society in return for a similar privilege in respect of members of the R.P.S. and our own Library.

Suggestions for improving Library facilities for members are welcomed by the Library Committee, and will be given sympathetic consideration.

G. J. CRAIG,  
*Chairman, Library Committee.*

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## LECTURE PROGRAMME — AUTUMN 1952

Meetings (excepting those marked \*) will take place at the Gaumont-British Theatre, Film House, Wardour Street, London, W.1. On November 5 and 26 they will take place at the Hammer Theatre, Hammer House, Wardour Street. The evening meetings will commence at 7.15 p.m., and the Sunday meetings at 11 a.m. The visit to Messrs. Kodak Ltd. (Harrow Factory) will commence at 2.15 p.m. Admission is by ticket only, obtainable from the Secretary before September 21, 1952.

### SOCIETY MEETINGS

- October 1 ... "The Viewing of Moving Pictures (Film and Television)," by W. D. WRIGHT, A.R.C.S., D.Sc.  
(Joint Meeting with the Television Society).
- \*October 4 ... Visit to Messrs. Kodak, Ltd. (Harrow Factory).
- \*November 5 ... "The Application of Film Recording Technique to Aeronautical, Geophysical and Medical Research," by D. FORRESTER (Fellow).
- December 10 ... "The Quality of Television and Kinematograph Pictures," by L. C. JESTY, B.Sc., M.I.E.E. (Member), and N. R. PHELP.

### 16 mm. FILM DIVISION

- October 8 ... "The Presentation of 16 mm. Films," by H. S. HIND, A.M.I.E.E., F.R.P.S. (Fellow), Chairman, Presentation Sub-Committee.
- November 12 ... "The Standardisation of Sound Quality on 16 mm. Release Copies," by N. LEEVERS, B.Sc., A.C.G.I. (Fellow), Chairman, Sound Recording Sub-Committee.

### THEATRE DIVISION

- October 12 ... "The Film Studio—The Development of its Equipment and its Operation," by B. HONRI, A.R.P.S. (Fellow).
- December 14 ... "Film Damage, its Cause and Prevention—A Progress Report," by A. E. ELLIS (Member).

### FILM PRODUCTION DIVISION

- October 15 ... "Separation Negatives and Positives for Colour Films," by P. JENKINS, A.R.P.S. (Member), and G. W. ASHTON, A.R.P.S.
- December 17 ... "Aerial Filming for 'The Sound Barrier'," by ANTHONY SQUIRE (Member).

### TELEVISION DIVISION

- September 24 ... "Television Advances in the Film Industry," a symposium including :  
    "Inlay Process for Television Productions," by A. M. SPOONER, B.Sc.(Eng.), A.M.I.E.E.  
    "Considerations Affecting the Design of Television Cameras," by G. C. NEWTON.  
    "The Power Operated Run Truck," by C. VINTEN (Member).  
    "The Use of the Radio Talk-Back Unit in Television Productions," by R. TOOMBS, B.Sc. (Eng.), A.M.I.E.E., D.I.C.
- \*November 26 ... "The B.B.C. Television Newsreel," by P. H. DORTÉ, O.B.E., A.M.I.E.E. (Member).

### LEEDS SECTION

Meetings will be held either at the Scala Ballroom, Leeds, or the Y.W.C.A., Cookridge Street, Leeds, at 10.30 a.m.

- September 19 ... "Developments in Fluorescent Lighting, including its applications to Stage and Outdoor Flood Lighting," by H. H. BALLIN, Ph.D., B.Sc.(Econ.), F.I.E.S.
- October 24 ... "Heating and Ventilating Equipment and its Uses," by H. E. WHITNEY, A.M.I.E.E., A.M.I.H.V.E.
- November 21 ... "Westinghouse Arc Rectifiers," by S. A. STEVENS, B.Sc.(Eng.), M.I.E.E. (Fellow).
- December 19 ... "Drive-in Theatres," by W. FLAHERTY (read by A. BUCKLEY, Member).



## A TEST TO MEASURE THE FLAMMABILITY OF KINEMATOGRAPH SAFETY FILM

R. W. Pickard, B.Sc. \* and D. Hird, B.Sc. \*

THE work described in this note was carried out at the request of British Standards Institution Technical Committee CME/6. Its purpose was to investigate the relative fire hazard of various types of safety film marketed to-day with other comparable cellulosic materials in common use.

### Development of Apparatus

Some preliminary work was carried out to compare the fire hazard of safety film

In the light of these results it was considered that if a specimen of safety film were mounted in a semicircular form, and ignited at one end, it would continue to burn to a point which would be characteristic of the particular type of film. This may be explained by considering the heat transfer between the flame and the film. The flame front continues to advance provided the film directly in front of the flame is heated to its ignition temperature. Initially, when the flaming is taking

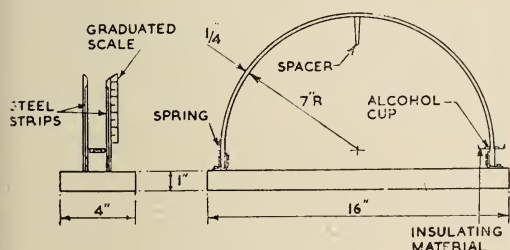
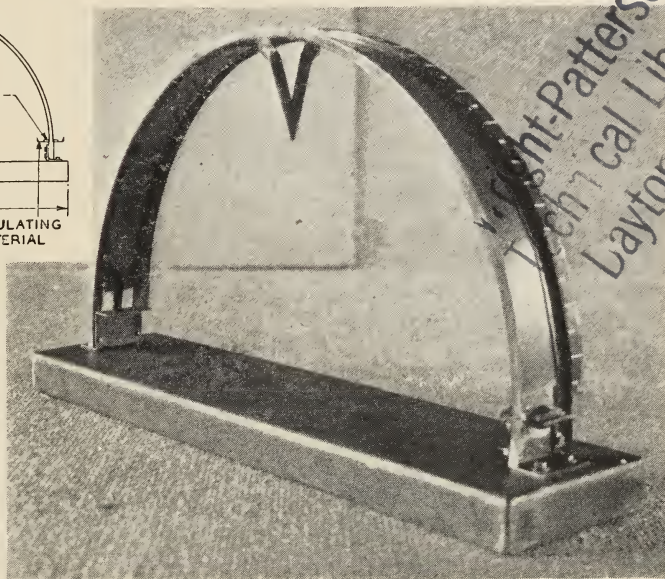


Fig. 1.

Apparatus for tests  
on 35 mm. film.



with the known hazard of nitrate film. To do this, a length of 35 mm. safety film was mounted vertically and its lower end ignited. It was found that the flame spread upwards over most types of safety film. However, if the upper end of the specimen were ignited, in no experiment did the flame spread downwards. Nitrate film subjected to the same test permitted the spread of flame in either direction.

Manuscript received July 23, 1952.

place on the section of film which is vertical or nearly vertical, the film directly in front of the flame is heated by convection and radiation from the flame. As the flame front advances towards the horizontal section of the film the contribution of heat from the flame decreases since the angle between the plane of the flame and the film increases. A point may therefore be reached at which the heating received by the film from the flame is insufficient for burning to continue.

\* Department of Scientific & Industrial Research and Fire Offices' Committee Joint Fire Research Organization.

This point is determined by the nature of the film under test.

Tests carried out on 35 mm. film showed that nitrate film would continue to burn over 21 in. of the perimeter of a 14 in. diameter semicircle, whereas safety film burnt up to a length of 16 in. on the perimeter. The relative flammability of safety film and other materials in the same form could be assessed from the length to which each material continued to burn.

The distance of flame spread for any one specimen in these preliminary tests was generally greater when the emulsion was upwards and so in all subsequent tests the film specimens were mounted in this way.

#### Apparatus and Experimental Procedure for 35 mm. Film Tests

The apparatus on which the tests on

35 mm. film were carried out is shown in Fig. 1. Two steel supports in the form of a 14 in. diameter semicircle were mounted on a steel base, with their adjacent edges 1 in. apart. One support was graduated at inch and half-inch intervals over a length of 21 in. A copper cup 1 cm. by 2 cm. by 0.3 cm. was mounted on an insulating base between the two supports at one end of the semicircle. A 21 in. length of film was held in position over the supports by means of two thin steel strips.

The test was carried out as follows: 0.3 c.c. of absolute alcohol were introduced into the copper cup and ignited. The distance over which the film burnt was noted.

Six specimens of each type of film were tested in this way and the mean distance of spread for each is shown in Table 1.

Table I  
DISTANCE OF SPREAD OF FLAME ON 35 mm. SAFETY FILM

Specimen	Thickness in. $\times 10^3$	Mean distance of flame spread in.
A. Base	5.3	Film did not continue to burn after the alcohol flame had burnt out.
A. Emulsion coated	5.9	12
A. Processed	5.8	Film did not continue to burn after the alcohol flame had burnt out.
B. Base	5.7	5
B. Emulsion coated	5.9	11
B. Processed	5.8	11.5
C. Base	5.3	11
C. Emulsion coated	5.7	12.5
C. Processed	5.7	12.5
D. Base	5.4	Film did not continue to burn after the alcohol flame had burnt out.
D. Emulsion coated	5.9	Film did not continue to burn after the alcohol flame had burnt out.
D. Processed	5.9	Film did not continue to burn after the alcohol flame had burnt out.
E. Base	5.3	5
E. Emulsion coated	5.5	13.5

Table I—continued

F. Base	5.7	13.5
F. Processed	5.8	13
G. Base	5.6	Film did not continue to burn after the alcohol flame had burnt out.
G. Processed	5.5	Film did not continue to burn after the alcohol flame had burnt out.
H. Base	5.0	Film did not continue to burn after the alcohol flame had burnt out.
H. Processed	6.1	Film did not continue to burn after the alcohol flame had burnt out.
I. Base	5.8	11.5
I. Processed	6.0	11
J. Base	5.8	Film did not continue to burn after the alcohol flame had burnt out.
J. Processed	6.0	Film did not continue to burn after the alcohol flame had burnt out.
K. Processed—not hardened	5.8	11
K. Processed—hardened	5.8	11
L. Processed—not hardened	5.0	12.5
L. Processed—hardened	6.0	11
M. Processed—not hardened	5.8	11.5
M. Processed—hardened	5.7	11.5
Acetate base with 3 per cent. cellulose nitrate as a surface coating	5.7	Film did not continue to burn after the alcohol flame had burnt out.
Negative film on acetate base with cellulose nitrate surface coating	6.2	11
Safety positive no silver image	6.1	Film did not continue to burn after the alcohol flame had burnt out.
Safety positive developed black	6.1	6

### Experimental Procedure for 16 mm. Film

Because 16 mm. kinematograph safety film is widely used, a test to cover this size of film is also necessary. Preliminary tests were carried out using an apparatus similar to that shown in Fig. 1 but with the adjacent edges of the two semicircular steel supports 12 mm. apart. Some specimens of film which had been tested on the 35 mm. apparatus were cut down to 16 mm. The results showed that these specimens burnt to a

length less than that on the 35 mm. apparatus. This result was to be expected since the flame was much smaller and the heating by convection and radiation was therefore considerably reduced. When the flame died out, the angle of the film (to the vertical) at that point, was noted and the second apparatus was altered so that this angle was obtained at a distance equal to the distance of spread on the 35 mm. test. In this way it was found that the diameter of the semicircle should be



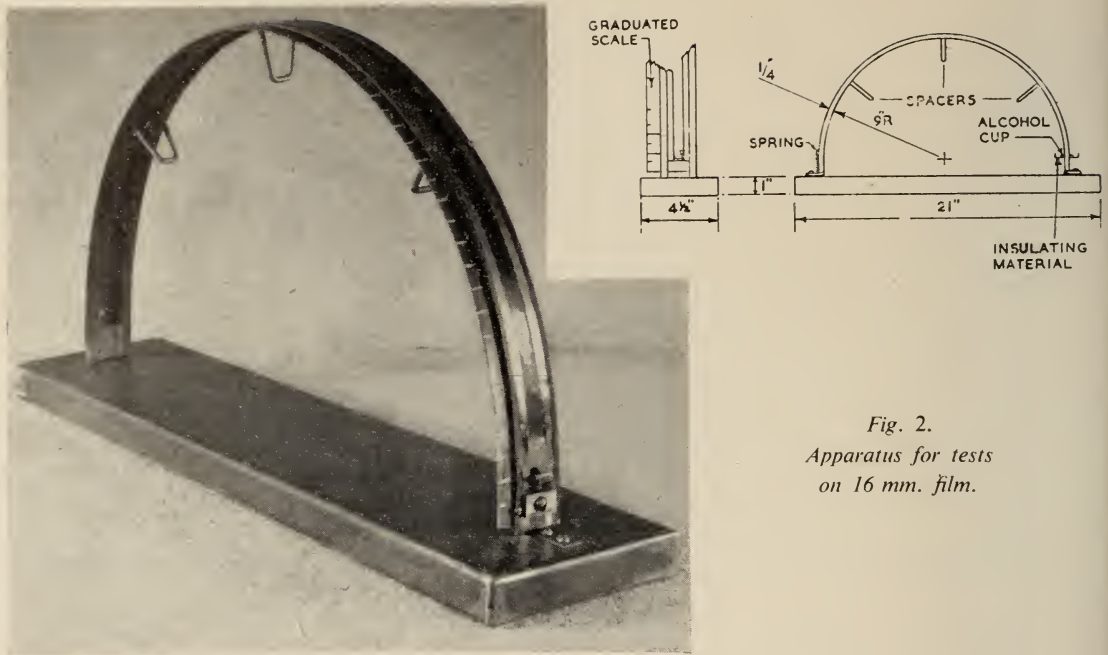


Fig. 2.  
Apparatus for tests  
on 16 mm. film.

18 in. for the 16 mm. film test. It was felt desirable to obtain this result for the sake of uniformity between the two tests.

The apparatus which was used for testing specimens of 16 mm. film is shown in Fig. 2.

It is essentially the same as that used for testing the 35 mm. film. The two semi-circular supports, of 18 in. diameter, were mounted with their inside edges 12 mm. apart. A copper cup 1 cm. by 1 cm. by 0.3 cm. was

Table II

DISTANCE OF SPREAD OF FLAME ON 16 mm. SAFETY FILM

Specimen	Thickness in. $\times 10^3$	Mean distance of flame spread in.
K. Processed—not hardened	5.6	12.5
K. Processed—hardened	5.7	6.5
L. Processed—not hardened	5.8	12.5
L. Processed—hardened	5.8	6
M. Processed—not hardened	5.3	11.5
M. Processed—hardened	5.3	7
N. Base	5.7	Film did not continue to burn after the alcohol flame had burnt out.
N. Processed	6.3	Film did not continue to burn after the alcohol flame had burnt out.
O. Base	5.7	5
O. Processed	5.9	6

mounted on an insulating base between the two steel supports at one end of the semi-circle. The film was held in position by two steel strips passing over the semicircular supports.

The method of testing was identical with that already described for the 35 mm. film. 0.3 c.c. of alcohol were used as the igniting source and the distance the film burnt was noted.

Six specimens of each type of film were tested, the results are given in Table II.

### Tests on other Cellulosic Materials

In order to compare the hazard of safety film with other cellulosic materials in the same form, specimens of nitrate film, newsprint, cartridge paper, cotton and rayon were subjected to the same test in both 35 mm. and 16 mm. widths. Six specimens of each material were tested and the results are shown in Tables III and IV.

### Discussion of Results

Rayon appears to be more hazardous than

Table III

DISTANCE OF SPREAD OF FLAME ON CELLULOSIC MATERIALS 35 mm. IN WIDTH

Specimen	Thickness in. $\times 10^3$	Mean distance of flame spread in.
Nitrate film—emulsion coated	5.9	Still burning at 21 in.
Newsprint—I ( $1.15 \times 10^{-3}$ oz/sq. in.)	2.9	17
Newsprint—II ( $1.21 \times 10^{-3}$ oz/sq. in.)	3.5	Still burning at 21 in.
Cartridge paper ( $3.32 \times 10^{-3}$ oz/sq. in.)	7.6	19.5
Cotton print ( $2.77 \times 10^{-3}$ oz/sq. in.)	8.6	Still burning at 21 in.
Rayon ( $3.86 \times 10^{-3}$ oz/sq. in.)	5.0	Still burning at 21 in.

Table IV

DISTANCE OF SPREAD OF FLAME ON CELLULOSIC MATERIALS 16 mm. IN WIDTH

Specimen	Thickness in. $\times 10^3$	Mean distance of flame spread in.
Nitrate film—emulsion coated	5.9	Still burning at 27 in.
Newsprint—I ( $1.15 \times 10^{-3}$ oz/sq. in.)	2.9	19
Newsprint—II ( $1.21 \times 10^{-3}$ oz/sq. in.)	3.5	Still burning at 27 in.
Cartridge paper ( $3.32 \times 10^{-3}$ oz/sq. in.)	7.6	19
Cotton print ( $2.77 \times 10^{-3}$ oz/sq. in.)	8.6	Still burning at 27 in.
Rayon ( $3.86 \times 10^{-3}$ oz/sq. in.)	5.0	20.5

safety film, yet both consist essentially of the same material, cellulose acetate. This may be due to two factors. First, rayon material has a larger specific surface than safety film and secondly safety film contains plasticisers which may tend to inhibit the flames.

## Conclusions

Whilst the tests described do not give an absolute measurement of the flammability of the materials tested, they do indicate that the flammability of those safety films which have been examined is less than that of nitrate film, newsprint, cartridge paper, cotton and rayon. This conclusion is based on the final

distance of flame spread for each type of material.

## Acknowledgements

The work described in this paper forms part of the programme of the Joint Fire Research Organization of the Department of Scientific and Industrial Research and Fire Offices' Committee; the paper is published by permission of the Director of Fire Research.

The authors wish to express their indebtedness to Mr. D. I. Lawson for suggestions which led to the design of the apparatus. Thanks are also due to Miss J. E. L. Walters for assistance in some of the experimental work.

## BOOK REVIEW

*Books reviewed may be seen in the Society's Library*

**NEWSREELS ACROSS THE WORLD.** *Peter Baechlin and Maurice Muller-Strauss. Published by U.N.E.S.C.O. (H.M.S.O.), 10s. 6d.*

Although newsreels are seen by more people than any other kind of film they are curiously undocumented. 215 million people, about one-tenth of the population of the world, go to the cinema and most of them see a newsreel but, so far as I know, this is the first book ever published on the newsreel industry. U.N.E.S.C.O. undertook the study because the cinema is one of the principal media of mass communication and the book is presented as an "objective, world-wide survey." In truth, it is an extremely critical examination of its subject, deploring the average content of the reels and their failure to give "adequate presentation of current events." To add to the unhappiness of the newsreel technician the final note of the book is that in any case the cinema newsreels are about to be superseded by daily television reels. The writers seem to hail television as the answer to the problem of telling the world about the world, but without a shred of evidence that television newsreels do any more than cinema newsreels to better world understanding. There are many of us who would like to raise newsreel production to a higher intellectual plane but the facts remain that the public go to cinemas to be entertained, not educated, and they expect their news unvarnished. The occasional interpretative story or an issue devoted to a single important theme will always be accepted but a *Times* newsreel editorial policy applied to a *Daily Express* cinema circulation will put a newsreel out of business. It is the exhibitor who is the publisher and he will refuse to show a newsreel which is too far in advance of his estimate of his audience. The newsreels can keep a pace ahead of public taste but not a mile. I am afraid that the authors of "Newsreels Across the World" can be numbered among those who think in

terms of film as providing a platform for what they want to say, without making allowance for what the public is prepared to hear.

Where this book excels is in its analyses and presentation of facts and figures. There is a most interesting breakdown of contents of the world newsreels and, published for the first time, a very complete study of the sources of film news and the international exchange of material. There is much new information about the ownership of newsreels and their controlling interests. It emerges that probably only the British and American reels are free of Government control in some form or other, and only the British reels appear to be uncensored.

In this 100-page survey only a few pages are given to technical and production matters. Apart from a revival of the hardy annual that the entire newsreel operation could be on 16 mm. nothing new is put forward. In dooming the cinema newsreel and focusing their sights on television, the authors have completely overlooked the obvious new development, the televised cinema newsreel. Television newsreels are little different from film newsreels except that they are transmitted by television. The real use of television for news transmission will come when big-screen television is established and cinema newsreel units will feed live news on to cinema screens as the events take place, at the same time preparing a film version which can be edited and augmented with "live" material for showing at later performances. For this reason I disagree with the authors that the dissemination of visual news will pass from the cinema to television stations. The cinema will use the short-cuts of the newer medium to maintain and improve its news service to audiences, and I forecast that in the years to come the cinema will be presenting news in colour *via* big-screen television long before the home viewer can enjoy a colour television news service.

HOWARD THOMAS.



## LATENSIFICATION

Paul Raibaud.

**I**N certain cases material conditions imposed in shooting do not permit subjecting the emulsion to sufficient light to obtain an acceptable image. To remedy this, one is tempted to resort to forced development or to intensification of the image after normal development, but these treatments give either a distortion of tone values, insufficient improvement or unacceptably large grain size. The use of a much faster negative emulsion is obviously the best solution. Stock manufacturers have made considerable efforts in this direction but the actual state of present technique limits the maximum value that it is possible to give to emulsion speed while preserving the other essential qualities of a sensitive layer: consistency, stability and small grain size. Accordingly, in case of absolute necessity one sometimes tries, just before use, the hypersensitisation of the emulsion which while giving interesting possibilities is unfortunately rather precarious.

There is, however, another method of obtaining more speed from emulsions: the reinforcement of the latent image, an operation which is carried out after exposure but before development. It is known that as soon as a sensitive layer is acted upon by light, a molecular transformation takes place, all but instantaneously, forming the latent image. It has been shown that this latent image, without other external influence, undergoes in the course of time a change in the form of a very small strengthening, which takes place however at a rapidly diminishing rate. This change may be considered in practice as stabilised after 20 hours; it continues at an extremely slow rate but with a definite effect after a much longer time. This spontaneous growth is obviously of little practical use for not only is it insufficiently immediate in action, but the

chance of changes due to the celluloid support must be present.

There are, however, rapid methods of reinforcing the latent image, either by various chemical processes, or by physical methods, which are more practical and economic. These methods may generally be described by the English word "latensification" (abbreviation of latent image intensification) and already the term seems, nowadays, to be specially reserved for the method of using a uniform supplementary post exposure and we shall use it in this practical sense.

### Origin of Latensification Procedure

It is not more than about twelve years since methods of using latensification to the full have been well known. The effects of a uniform auxiliary illumination have been known since the very early days of photography, but only in part, and served mostly the field of research for analysing the complex processes of the action of light on sensitive emulsions and for attempting to discover the mechanism of the formation of the atomic chain in the latent image. H. W. Moyse, in an article,<sup>1</sup> recounts the origin of the practical use of latensification. In 1939, an American technician at the Dupont Research Laboratory, Mr. Robert Cabeen, reported one day that certain sensitometer strips showed by comparison with other specimens, normally identical, an abnormal growth in density in the lower part of the characteristic curve. He discovered that this anomaly was due to the fact that these sensitometer strips, after having been exposed in the sensitometer and before being developed, had by chance remained for a fairly long time exposed to a very feeble illumination. Experiments were undertaken in a systematic manner and confirmed the fact that a very weak uniform auxiliary illumination of certain duration caused a very marked reinforcement of the latent image.

Reprinted from *La Technique Cinématographique* No. 114, June, 1952, by courtesy of the Editor and the Association Française des Ingénieurs et Techniciens du Cinéma, and translated by R.J.T.B.

### Characteristics of Treatment by Latensification

Fig. 1 shows the characteristic curve of a panchromatic emulsion developed for the normal time to obtain the usual gamma of 0.65 (curve "N"). The fog density is 0.04 and the threshold of sensitivity is at point A. If, before development, the emulsion is submitted to a uniform auxiliary exposure (for example 15 minutes at a sufficiently low illumination for the fog density to be increased only by 0.05) one obtains, under identical conditions of development, the result shown in curve "L," which is characteristic of a latensified emulsion. Although the resultant fog reaches a density of 0.09, the threshold of sensitivity is now found at point "B."

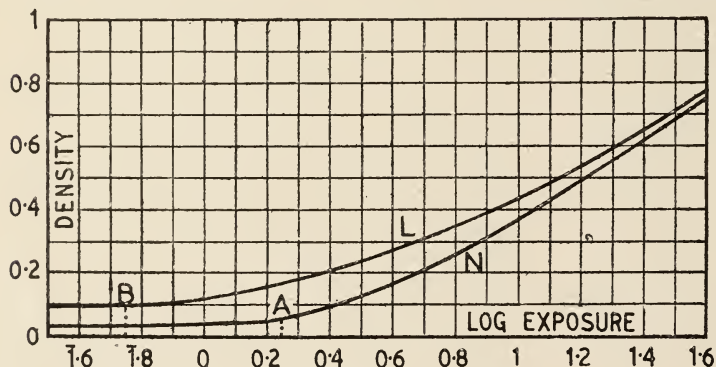


Fig. 1.

The lower part of the characteristic curve of a modern panchromatic film. Curve N—normal development. Curve L—after latensification, same development.

If  $E_1$  is the maximum illumination which, on exposure, would start to affect the unintensified emulsion, we have at point A on curve N,

$$\log E_1 = 0.25$$

After latensification this minimum effective illumination will now be only  $E_2$  at point B on curve L,

$$\log E_2 = \bar{1}.70$$

In the example given above,  $E_2$  is three and a half times lower than  $E_1$ . If we call this coefficient of decrease "g," we can say

$$g = \frac{E_1}{E_2} \therefore \log g = \log \frac{E_1}{E_2} =$$

$$\log E_1 - \log E_2 = 0.25 - \bar{1}.70 = 0.55,$$

that is,

$$g = \text{anti log } 0.55 = 3.5,$$

so in this case latensification allows us to

expose with three and a half times less light. It must be pointed out, however, that the reinforcement is most effective for very low levels of the original exposure and has less and less effect on higher levels of illumination. One sees, too, that the gradation being extended, the curve L gives a lower slope, so that after latensification the apparent contrast of the image will necessarily be less if conditions of development remain identical. To obtain an image of equal contrast it is necessary, therefore, when using latensification treatment to give longer development in order to reach the same gamma.

The danger lies in increasing the grain size to an unacceptable level. This would not happen with the negative emulsion normally used in cameras. On the other hand

it is not recommended to attempt latensification of ultra high speed emulsions. Grain size, which is already at the maximum acceptable level, would become excessive with the increased time of development made necessary. The optimum conditions for successful latensification may now be set out.

The latensifying action of the auxiliary light is a function of both the level of the light and its duration, but these two functions are not reciprocal; that is to say, the reciprocity law ceases to be true (or in simple terms, a certain auxiliary light,  $E$ , applied for  $T$  seconds does not give the same result as a light  $5E$  applied for  $\frac{T}{5}$  seconds). In these

two cases, although the intrinsic value of the two exposures is the same, the effective value



is greater in the first case than in the second. To a certain extent, in so far as it effects latensification, light acts more by its duration than by its intensity. However, as the action of latensification increases the fog, the intensity of the auxiliary light must be limited to such a value that the additional fog density so produced does not encroach on the latensifying effect; thus this auxiliary illumination must be such that, by comparison with the same emulsion not latensified and normally developed, the fog density after latensification must be increased only by a few hundredths after development to the same gamma. Generally this increase in fog will be found to be around a value of between 0.05 and 0.10. The latensifying effect in-

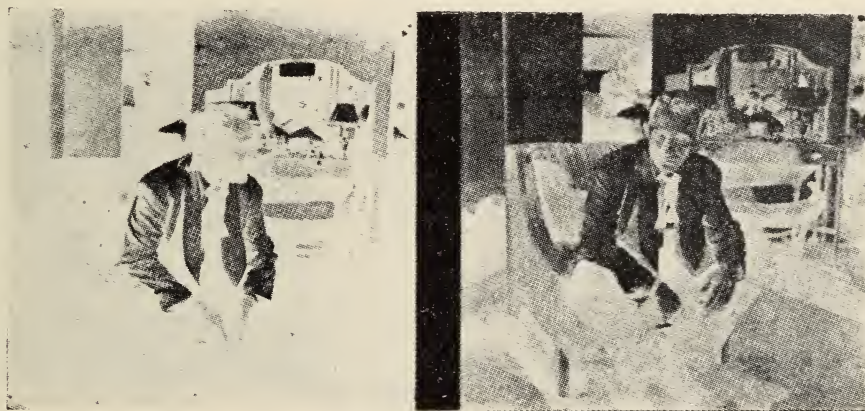
optimum value. The colour of the light used in latensification is unimportant, there being practically no difference in the result obtained so long as the illumination used is in the visible spectrum.

### Applications for Latensification

It was in 1946 that the Paramount Studios in Hollywood first began to use latensification, but at first only to obtain the usual stills for a production. In fact, the speed being three or four times that normally obtained, the photographer was able to use a very short exposure and thus obtain very clear negatives of action during the production (Fig. 2) whence a double advantage, firstly a substantial economy for the production by saving

Fig. 2.

*Stills negative showing results of latensification—same very short exposure in both cases during action on the floor. Left, normal technique—badly underexposed. Right, after latensification.*



creases with the time of application but is greatest during the first few minutes. The effect continues although with diminishing speed of growth right up to the optimum duration, which is generally of the order of 60 to 100 minutes. In practice latensification is usually carried out for 10 to 15 minutes, an exposure of the order of 60 minutes being, in fact, too long to be economically useful except in extreme cases where the original exposures have been made under unusually bad conditions.

Apparatus for the latensification of negatives can be in a very simple form; a cupboard in which the film is rewound for the desired time in front of a uniformly lit field. The source of light used must be extremely accurately adjusted and maintained at the

the usual time taken for posed stills; secondly, the securing of true action photographs which were much more lifelike, the photographer being able to choose the most interesting and natural pictures during the actual shooting in the studio.

Since 1947, the Paramount Studio has extended the use of latensification to kinematograph negatives, principally when shooting in natural surroundings and for night scenes. Considerable economies have been made owing to a reduction in the amount of lighting equipment required. New possibilities also became realisable, for it is often practically impossible to light natural scenes; for example, in the film "Beyond Glory" a large part of the action took place at the Military Academy at West Point. One scene



shows the Cadets' vast dining hall. This hall is of enormous dimensions, being able to seat 2,000 diners. It was, however, filmed by the daylight given through its windows, aided only by illumination of the normal candleabra in the hall and without a single additional lighting unit. On an ultra rapid film, of 100 Weston speed, the negative was considerably underexposed (Fig. 3). On normal film, of 64 Weston speed, after latensification the negative image was correct, as can be verified by anyone who saw the film.

Latensification is of enormous benefit when scenes must be shot with great depth of focus in order to obtain as much clarity in the foreground as in the background. One can, of course, work with a very small aperture which needs very much more lighting. In the film "Sunset Boulevard" can be seen, for example, two characteristic scenes, one, where, dominating the foreground, are the bandages of the fallen star after her failure to commit suicide, while the young scenarist enters in the background; the other where, in close-up, the white-gloved hands of the Maitre d'Hôtel run over the organ keys while at the end of the immense room action continues clearly visible. To obtain sufficient clarity without latensification the lens used in normal scenes at F 2.2. would have to be stopped down to F 7, the comparison of the lights needed in the two cases is that of the square of the aperture numbers, i.e.,

$$\frac{2.2^2}{7^2} = \frac{4.84}{49} = \frac{1}{10}$$

that is to say, it would have needed for the scenes in question an illumination ten times more intense, which was prohibitive from two points of view: the long time needed to rig such lights which is very costly in production time, and also the high price of the electricity so consumed. The use of latensification enabled the scene to be shot at F 3.5 instead of F 7. The lighting was only increased by

$$\frac{3.5^2}{2.2^2} = \frac{12.25}{4.84} = 2.5 \text{ times,}$$

a permissible increase.

In "Sunset Boulevard" latensification was

used in 15 per cent of the finished film, notably the scenes with great depth focus, as well as various exteriors and actual street scenes shot at night with restricted lighting.

Latensification is also very useful for scenes in which back projection is used. The screen is often placed rather far from the foreground where action is taking place, either because of the decor or in order to remove the screen from the zone of direct foreground lighting. In such cases the difficulty of reproducing the projector image clearly on a negative is a thorny problem; in fact the depth of focus compels the use of a very small aperture,

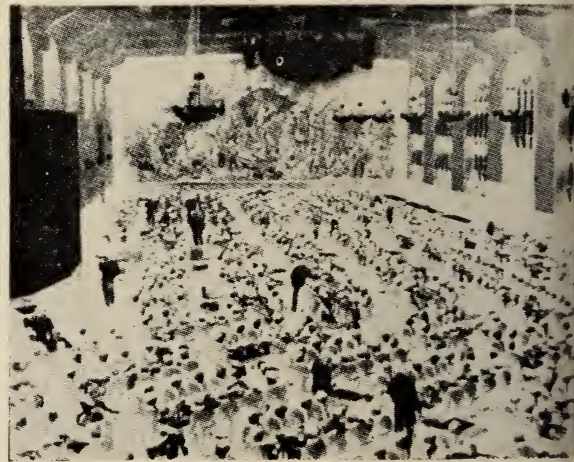


Fig. 3. Enlargements of 35 mm. frames from the right on 64 Weston negative but latensified.

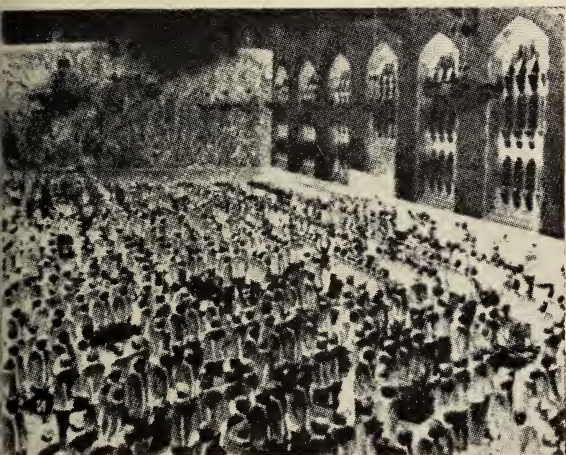
had correct exposure

necessitating an increase of the foreground lighting in proportion and to counter this (but at a level generally impossible) an increase in the projection light thrown upon the background projection screen.

Latensification gives, in a manner both possible and economic, the desired solution. It will also allow the possibility of shooting the very largest back projection screens for which, without latensification, the projector lighting would be too feeble. In the same way one could shoot with a short focus objective in front of a back projection screen, of which the edges of the projected image are obviously insufficiently illuminated, while the

centre of the screen is too well lit. The relatively greater central luminosity is corrected by the usual masking, the foreground lighting is matched and latensification will give a correct image.

Latensification is indispensable for newsreels when it is imperative to take live scenes under bad lighting conditions such as bad weather, too early an hour in the morning, too late in the evening, night scenes, sports events and similar difficult circumstances. In the same way, producers of publicity and documentary films and others with a limited budget will derive enormous benefits from



... showing the dining hall at West Point, on the left. The negative on the right is the original in the film.

the latensification technique.

In Hollywood latensification is now used

quite widely in all the big studios, and nearly all laboratories are equipped for carrying out the process ; for example, the Paramount Studios use latensification for two-thirds of their films ; Columbia Pictures utilise the technique systematically for all their " B " pictures in which the standard lighting level of 1,200 lux has been reduced to 500, effecting in this way a 60 per cent reduction in lighting costs. At the level of 500 lux, films are shot at F 2.8 on Kodak Plus X.

### Editorial Note from the French publication :

*The advantage of latensification are such that in the U.S.A. it has now become a normal auxiliary service in all cinematographic and photographic processing of negatives.*

*It would be good if French production of all sorts could also benefit by it. We wish that all our cinematographic and photographic processors would equip themselves for the routine use of latensification. The apparatus is relatively simple to construct without undue financial outlay.*

*We see no obstacle to prevent our laboratories, at least in this field, from following the march of progress.*

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\* In view of the above comments by the Editor of *La Technique Cinématographique*, it is of interest that in this country Denham Laboratories are already equipped for latensification treatment, although they would certainly disagree with some of the statements made in the article, particularly those referring to the types of film stock on which latensification treatment can be successfully carried out.

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## WRITING A TECHNICAL PAPER

G. Parr, M.I.E.E. (Fellow)\*

**M**OST technical people dislike writing articles or papers, and are even more averse to reading them to an audience. This aversion is particularly unfortunate, as the technical paper is almost the only way in which any serious worker can bring the results of his experience and effort to the attention of his colleagues.

He may design a piece of equipment, but it usually appears on the market under the trademark of his firm and not his own name. He may make a brilliant contribution to his own branch of science, but unless it is described in print, it will go unnoticed by all except a narrow circle. Whatever the work, it will best be remembered if it is put on record.

The difficulty which most technical men find in expressing themselves is probably due to lack of training, which in turn is due to lack of time. There is so much to be acquired in the short years of study at technical colleges that technical writing can find no place in the syllabus, and it is usually assumed that the knowledge of grammar and composition obtained in school is sufficient to enable a student to express himself clearly and concisely on any abstruse technical subject. This assumption is very far from reasonable, as most research workers will agree. In order to earn a place in technical literature to-day a paper requires as much care in preparation and skill in execution as any piece of research or development of apparatus.

Although the art of technical writing is now being given the attention it deserves, the subject is too complex to enable it to be brought down to a series of rules, and any instructions in the technique must necessarily be general rather than precise. Further, if one attempts to write according to a textbook, the style quickly becomes stereotyped and the object of the instruction is defeated.

The suggestions which are made in this paper are therefore only in the nature of guidance, and moreover, are only those of one writer. It is one of the attractions of writing that differing views may be held on a very large number of points of style, syntax, and even spelling, and if an author continually reviews his work as it might appear to a fellow author he very soon improves in clarity.

(As an example of this self-criticism, the previous paragraph has been left untouched. On re-reading it, the writer would note that the word "very" has been used twice: once with possible improvement of emphasis, but the second time quite unnecessarily. The question one asks mentally is "Does the word 'very' really add emphasis? and so on...")

### Planning a Paper

The majority of circuits and equipment follow a recognised plan in their development and it is one which is quite sound and familiar to all technical workers. The steps could be set down approximately in this order:

- Requirements
- Specification
- Parts List
- Prototype construction
- Checking and amending
- Final construction
- Testing

and there is no reason why this logical order cannot be used in the preparation of a technical paper. Certainly, it would be difficult to write a paper without a plan, just as it is time-wasting to make up apparatus without a drawing, but there are many writers who start with the first sentence and go on, hoping for the best.

Discussing the terms in the schedule, the first two determine the scope, length, and style of the paper. The "requirement" is the subject matter, and can usually be expressed clearly by the title, with or without

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Manuscript received July 25, 1952.

\* Chapman & Hall, Ltd.



a sub-title. If the title is well thought out it can set the whole scope of the paper, and an attractive title is good bait for the reader. A heading to a paper :

“Some Observations on the Apparent Distortion occurring in Projection Apparatus subject to Vibration”

may contain all the information that the reader requires about the contents, but it is not so appetising as :

“Projector Vibration : a Cause of Distortion”

The “specification” of a paper bearing this title might include :

Nature of Distortion ; Measurements made ; Projectors tested ; Other experiences ; Experiments to reduce Vibration ; Recommendations ; Conclusions,

and these headings will serve as a basis on which to gather and group material. The material gathered corresponds to the “Parts List” and includes all the data likely to be required in drafting the paper.

### Assembling Data

If a technical paper is the result of an experiment, the data obtained in the form of readings, calculations, and tables are ready to hand. It is more usual to write a paper to include not only the author's own work but also that of his contemporaries and for this it is necessary to spend much time in reading through the literature. It is not uncommon for an author to have to spend two or three weeks investigating references and information for a paper that will take him only as many days to write. It is here that a card index, or its equivalent in loose sheets of paper, is essential. Apart from the noting of actual references to other papers, a card index is useful for storing odd scraps of information heard in discussion, or even ideas which occur during work. A few 5 ins. by 3 ins. cards carried in the pocket are the best way of acquiring useful data for filing under the headings which have already been sketched out.

It is only when the whole of the relevant information is assembled in a convenient form that the actual drafting of the paper can begin.

If not, the writer may have to break off in

the middle of a theme to hunt for a useful fact, and the interruption may lose him the thread of the writing.

### The Reader

The reader is the most important person to be considered in the writing of a report or technical paper. This somewhat obvious statement needs to be emphasised, because a number of writers forget that they are also readers of other people's work and blithely commit the faults that they are the first to condemn in others.

The reader of a technical paper is usually busy and will not spare the time to unravel an involved sentence or find a hidden symbol in a mathematical expression. Instead he skips through the paper and is left with the impression that it is all very clever but the author is a poor hand at explaining things. As Professor Kapp once remarked : “We spend time and money making it easy for engineers to read instruments quickly and accurately, but a writer takes very little trouble to help a reader obtain the information with the same ease.”

There are several ways in which the reader can consciously or unconsciously be irritated. Most of them are in the omission of small details which are trivial in themselves but cumulate to produce a bad impression.

The principal causes of “reader irritation” are :

- (1) Long involved sentences, often with inadequate or wrong punctuation.
- (2) Taking for granted that the reader either knows all about the subject, or knows nothing about the subject.
- (3) Saying “obviously”, when the statement is not obvious.
- (4) Omission of steps in an argument, or slurring over the parts of the argument which are not clear to the writer himself.
- (5) Inconsistency.
- (6) A bad style, either making use of “woolly” words or disconnected sentences.

This list could be extended, but it is sufficient to recall to most authors other annoyances that they themselves have felt ; in

writing, as in most other occupations, "do as you would be done by" is an excellent precept.

### Details

Attention to details, particularly in a technical paper, is the hall-mark of a careful and accurate writer. As in most industries, there are agreed conventions and standards which should be observed in writing, and all authors should possess the necessary reference books and British Standards.

There are agreed standards for abbreviations, symbols, and technical terms, as for example BS.205 (Terms used in Electrical Engineering), BS.108 (Electrical Symbols), BS.530 (Graphical Symbols), and if all

made  
coils in the two cases, and it can be shown that by employing slightly different air gaps in the focusing systems used with the two tubes, the ampere-turns required can be identical. FIG. 8 is a graph relating the ampere-turns required for focusing both triode and tetrode tubes with varying focus coil air gaps. Both tubes were operated with the same E.H.T. and the same focus coil position. It will be seen that as the air gap is increased, the graphs for both types of tube reach a shallow minimum, in the vicinity of approximately 20 mm. gap. It was found, however, that with the coil used some deterioration of spot quality was encountered if a gap size larger than about 18 mm. was employed. Nevertheless it is possible to choose suitable air gap values for the two types of tube in which the ampere-turns are identical.

Fig. 1. Part of a galley proof showing the trouble and expense involved in adding a single word to the made-up column. To pack this word in, the type has had to be re-distributed over ten lines. Note also the error in the last adjusted line, which might not have otherwise occurred.

writers conformed to these there would be less ambiguity in diagrams and in the use of terms.

Another point of detail which may offend the reader is inconsistency. The name of an author may appear in one part of a paper as J. S. Brown and in another part as J. Brown, leaving the reader to guess whether they are one and the same. Measurements given in inches may suddenly be changed to metric measurements, or, more commonly, the units may be omitted altogether. Nearly every writer of a paper can recall having met similar irritations in another's work, and it is hoped that he will profit by the experience.

### References

The quoting of references to other papers is one of the details which require careful checking, as a misleading reference will send the reader on a time-wasting hunt through the literature. It is a safe rule never to quote another writer's reference without verifying the page and volume of the publication cited.

The standard method\* of quoting references is as follows:

JONES, A. C. On the curious behaviour of Flies. *Jour. Roy. Fly Soc.* 3, 32, 1933.

The name of the author is given first, the title of the paper second, and then follows the abbreviated title of the publication with the volume number (**in heavy type**), page number, and year of publication. From this

coils in the two cases, and it can be shown that by employing slightly different air gaps in the focusing systems used with the two tubes, the ampere-turns required can be made identical. FIG. 8 is a graph relating the ampere-turns required for focusing both triode and tetrode tubes with varying focus coil air gaps. Both tubes were operated with the same E.H.T. and the same focus coil position. It will be seen that as the air gap is increased, the graphs for both types of tube reach a shallow minimum, in the vicinity of approximately 20 mm. gap. It was found, however, that with the 1100 used some deterioration of spot quality was encountered if a gap size larger than about 18 mm. was employed. Nevertheless it is possible to choose suitable air gap values for the two types of tube in which the ampere-turns are identical.

example the need for careful checking is seen, as it is possible to transpose the volume and page numbers in setting down the reference.

### Style

Style in writing is one of those abstract qualities which are difficult to define, but which are recognised by their attributes. The attributes of good style are:

- (1) The careful choice of words combined with clear expression.
- (2) Avoidance of clumsy construction, cliché, and slang.

\* There are actually two standards, but the one given here is that usually in use in engineering and industrial publications.

### (3) Consideration for the reader.

In technical writing, more than any other form, it is essential to use the right word in describing or explaining a process or piece of equipment. Words which have a precise meaning are debased when used loosely, and when the writer wants to use them in their correct significance he finds that they have lost their merit. A good example of the debasing of a word is the non-technical use of "alibi" to mean "excuse." This was originally a legal technical term for a plea that the culprit was elsewhere at the time, but it has been so misused by journalists and others that it has now lost its proper meaning, and presumably the legal profession will have to find another word to take its place.

It is difficult to comment on clumsy sentences without giving examples, which would take up more room than is available in this paper, but intending writers would do well to avoid abstract sentences which in the majority of cases take up more room to say a plain statement than would be taken by the same sentence in a more direct form.

This is an example of a clumsily constructed sentence, which will probably need to be read twice before the meaning is clear. There are many better examples in the two excellent books by Sir Ernest Gowers: "Plain Words," and "The A.B.C. of Words," both published by the Stationery Office at a reasonable price.

Here are some pointers to guide the writer in good style :

- (a) The sentence or paragraph should never contain more statements (with their qualifying clauses) than the reader can take in without mental effort.
- (b) A welcome change in a long paragraph is to insert a short sentence to relieve the monotony, but a series of short sentences has a machine-gun-like effect and irritates the reader.
- (c) It is not sufficient to give the reader pause by inserting a comma, and most commas inserted for this purpose are unnecessary. In any case, the

commas should be inserted to correspond with the natural pause which would occur when the sentence is read aloud, and not because the writer thinks that it is time he put one in.

### Drafting the Paper

After the material has been set out, the preliminary draft of the paper can be made. It is here that adequate preparation will pay dividends and save time and "drying up" of ideas.

The main headings for the paper will have been set down as described under "Planning a Paper," and each of these main headings can be sub-divided into sub-headings,\* each one of which will give a clue to the sentences or paragraphs required. The paper is in effect taking on the form of a skeleton outline consisting of a series of connected nouns or phrases. Not all these headings may be used in the final form : some may be redundant, but they serve at this stage as pegs on which to hang the argument. It is seldom that a writer can prepare a draft which will contain all the information that he wishes to put down, and a series of headings will enable him to fill out or cut down the amount of material without too much trouble.

It is sometimes convenient at this stage to prepare a summary of the paper, which may be required for publication elsewhere. This summary should be about 5 per cent of the total length of the paper and should contain the important findings or facts and the conclusions drawn from them.

The advantage of preparing an early summary is that it serves as a guide to the balance of the paper, and if the writer has difficulty in preparing an adequate summary it is an indication that the paper is not planned as well as it could have been.

When the draft has been written it is helpful to set it aside for a few days or even weeks

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\* This faulty phrase "sub-divided into sub-headings" has been left in the text to illustrate the importance of reading through the draft carefully. It would be better to avoid the jingle by saying : "can be broken down into sub-headings".



(assuming that it is not required for publication by the next day !) so that the writer may take it up again with a fresh mind. In dealing with a subject that is familiar a number of imperfections in writing go unnoticed, and the gaps in the argument do not always appear. Better still, the draft should be read through by a colleague who is interested in the work and who does not mind discussing doubtful points with the author.

If both the writer and his conscience, or his colleague, are satisfied that the paper is reasonably complete, the final draft can be typed out with improvements in style and construction that are suggested by re-reading the original draft. Usually the writer is so anxious to finish the task that he does not spend enough time on re-reading and revision. If he does not, he will find faults

which affects the choice of illustrations is the cost of reproduction, and authors can hardly grumble at an editor who prunes down 24 photographs and drawings to a mere half-dozen, thereby saving £20 on the printing bill.

On the printed page a drawing or graph is reproduced by means of a "line block," in which the lines of the drawing stand out in relief on a zinc or copper plate. The drawing is reproduced photographically on the metal which is then etched away to remove the background.

For good reproduction the original should be drawn at least twice the size of the printed copy. It is frequently overlooked that the photographic reduction also thins down the lines of the original, and they should be drawn twice the desired finished thickness.

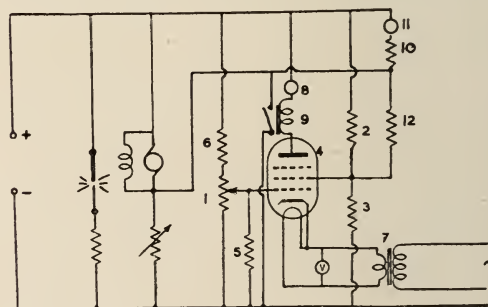
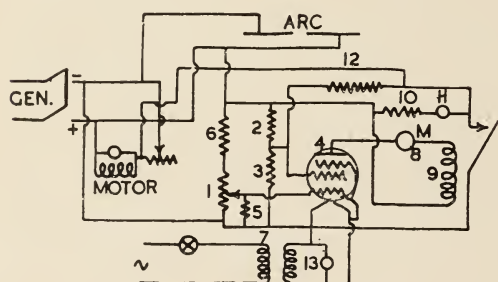


Fig. 2. Diagram of an automatic arc control circuit. Left : as drawn by an inexperienced author ; Right : drawn according to standard conventions. The readability is much improved by neat arrangement.

of style such as that left in the paragraph above (see footnote on page 75).

### Illustrations

So far no mention has been made of the illustrations, which are almost of equal importance with the manuscript in a successful paper.

The sketches and photographs accompanying the text will have been assembled with the rest of the material ("Parts List") and the writer will have to select the most suitable illustrations to match the text and help the explanation as efficiently as possible. The use of pictures which do no more than fill the space is not looked on with favour by technical readers. The over-riding factor

Graphs intended for reproduction should be drawn on paper with grey or blue background lines, which will disappear on a Process plate. The lines to be reproduced should be inked in black. Graphs should not be drawn on millimetric paper unless great accuracy in reading is required, as the squares tend to fill in with ink in the final printing from the reduced size of graph (see Fig. 3).

The grey background paper is also useful for drawing circuit diagrams or outline drawings of apparatus, and is very helpful to inexperienced draughtsmen. If an author is not accustomed to drawing it is better to ask an expert to produce the finished drawings. The regularity of the lines of printed type has the effect of showing up small

imperfections in a drawing which would be tolerable in a blueprint, and it is better not to spoil a paper by poor quality of drawing.

Mistakes made in line drawings need not be scratched out and can be obliterated by white paint or by pasting white paper over the fault. The special obliterating paint known as "Process White" is superior to ordinary Chinese White for this purpose, as it does not photograph grey on the negative.\*

Photographs are more expensive to reproduce than line drawings and should therefore be used sparingly. In any case it is not good practice to include a photograph which is only

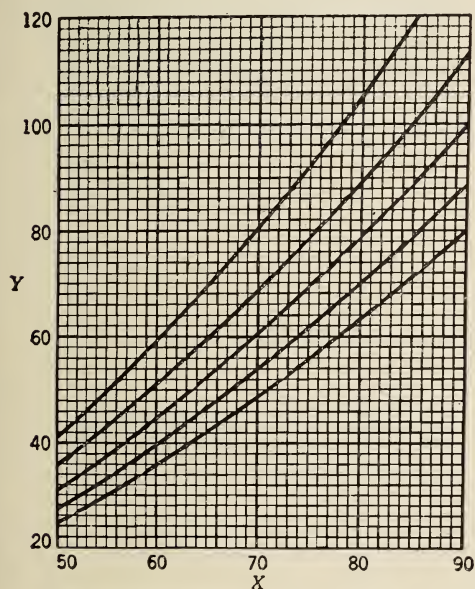


Fig. 3. Too fine a background makes the graph difficult to read, and is usually unnecessary.

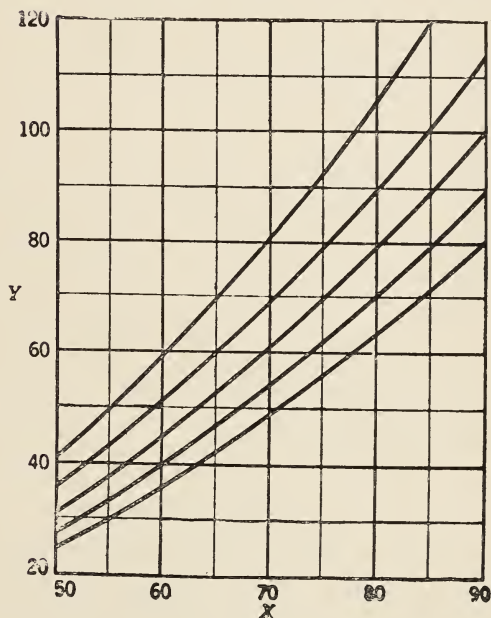
ornamental and does not convey a useful fact to the reader. The recommended size for photographs for reproduction is  $\frac{1}{2}$ -plate, on glossy paper with fair contrast.

### Checking

Before handing over the completed paper to be typed, the following tests should be applied. If the answers are satisfactory, the paper can be considered as up to standard.

\* Possibly due to non-absorption in the violet end of the spectrum.

- (1) Is the style consistent throughout, and suited to the reader ?
- (2) Can any of the statements be misinterpreted ?
- (3) Are the main ideas given proper emphasis ?
- (4) Are any unfamiliar terms explained ? Is the explanation snobbish ?
- (5) Are the illustrations clear and helpful to the explanations ?
- (6) Is the tone of the paper moderate and objective ?
- (7) Are the abbreviations of standard form and consistent ?



- (8) Are the references accurate, and have acknowledgements been made to other authors ?

### Finishing off

Papers intended for publication in this or any other journal should always be typed. Only geniuses can afford to send in their contributions in pencil on the backs of envelopes. To help the editor as far as possible, the typed matter should be on one side of the sheet, double spaced (in spite of



the cost of paper) and ample margin should be left on each side.

Each page of the typescript should be numbered, and additional pages should bear the preceding page number followed by "A" or "B." Additions to the typescript on the page should be gummed to the margin near the place for insertion and marked clearly "Insert at X."

All mathematical formulae should be printed very carefully by hand (unless the typewriter has a full range of mathematical symbols—a rare asset) and particular care should be taken over forming the Greek letters, subscripts and superscripts. The printer, like the typist, is not a mathematician and has to divine the meaning of any cryptic symbol which the author has written badly in the text.

The illustrations should not be included with the typescript, but assembled in order in a separate packet. Each illustration should be numbered and have an explanatory caption (legend) typed on a sheet attached to it.

If the material is finally checked and delivered to the editor in this form, the author will have the satisfaction of knowing that he at any rate has done his share towards producing a first-class paper.

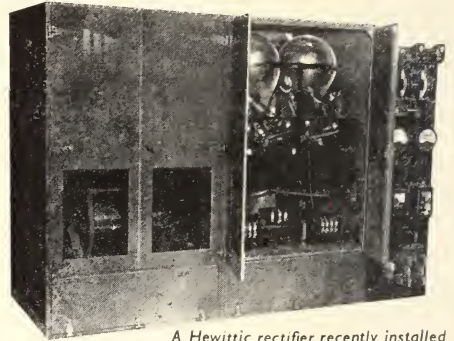
#### SITUATION VACANT

B.B.C. requires Engineer in Studio Equipment Section of Planning and Installation Department in London. Appointment will be in salary grade £795—£1,065. Duties include specification, ordering and testing of equipment used for transmission of films for television and for making films from television; planning complete installations including such equipment; liaison with manufacturers and supervision of contracts. Requirements include considerable practical experience in use of high-grade cinematographic equipment and thorough knowledge of principles of its design and of associated techniques relating to lenses, film stock, film processing, etc.; good knowledge of principles of television, and preferably some experience of application of films for television purposes. A degree in Electrical Engineering or Physics, or equivalent qualification desirable. Applications to Engineering Establishment Officer, B.B.C., London, W.1, giving details of qualifications and experience, within 7 days.

Small announcements will be accepted from Members and Associates. Rate, 4d. per word, plus 2s. for Box No. if required (except for Situations Wanted).

## REDUCE PRODUCTION COSTS

with modern, efficient converting plant  
for supplying STUDIO LIGHTING



A Hewittic rectifier recently installed  
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# BRITISH KINEMATOGRAPHY

VOLUME 21 No. 4

HON. TECHNICAL EDITOR :  
R. J. T. BROWN, D.S.C., B.Sc. (Fellow)

OCTOBER, 1952

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## THE PROJECTIONIST TRAINING SCHEME

A PROJECTIONIST has always required technical knowledge and ability to do his job but with the passage of time the extent of the knowledge he requires has increased.

The old hand-cranked silent projectors seem to us simple pieces of machinery with little of the complexity of the present-day machine. This process continues and the projector of to-morrow may make the present machine look as simple as the hand-cranked version.

The apprentice of to-day is the man who will be using the machines of to-morrow, and the object of the projectionist training scheme is to teach him all the basic knowledge necessary to operate these machines to the best advantage. It has, therefore, been designed not on the narrow basis of teaching 'which knob does what' but on the broadest possible foundations, teaching the fundamentals of the subject as well as their immediate application.

It is intended that the projectionist who has been trained in this scheme will be able to operate the machines of both to-day and to-morrow with the aid of a good and serviceable background of knowledge which he has learned how to apply. On such a foundation he can build the everyday methods which he will wish to use with his particular machine, be it a silent, sound, or television projector.

The aim of the Committee which has drawn up the syllabus for this course has been to give the apprentice the opportunity of acquiring knowledge which will be of use to him throughout his career. It has, therefore, recommended a syllabus which is not narrowly based on details of existing machines and present practice, but which is broadly based on the fundamentals of the subject and so will be applicable to whatever type of machine is used.

F. S. HAWKINS.

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# INTERNATIONAL CONFERENCE ON CINEMATOGRAPH STANDARDS

New York, 1952.

THE first meeting of the Cinematograph Technical Committee TC 36 was held under the auspices of the International Standards Organisation at Columbia University, New York City, on Monday, June 9, 1952. Admiral G. F. Hussey, Director of the American Standards Association, opened the proceedings. The International Standards Organisation had appointed the American Standards Association to provide the secretariat for the cinematograph technical committee and since it was usual for the Chairman of the committee to be of the same nationality as the secretariat, Dr. L. Knopp (U.K.) proposed and Dr. D. R. White (U.S.) seconded the motion that Mr. F. T. Bowditch, Engineering Vice-President of the S.M.P.T.E., be appointed Chairman. The motion was carried unanimously.

Mr. Donald E. Hyndman, a Past President of the S.M.P.T.E., and a member of the B.K.S., in extending a welcome to the delegates, said that as a result of past experience it was obvious that any proposal to change an accepted procedure or to standardise the dimensions, rating or performance of any material, must first pass through two critical tests. Firstly, the scientists, technologists and engineers must reach a unified decision acceptable to the majority and secondly, that the industry as a whole must be satisfied that the proposal will result in technological improvements such as will add to the quality of the product and make it more attractive to the public. Looking ahead, he thought it conceivable that television, like motion pictures, will become international in scope and future motion picture standards and performance characteristics will influence and perhaps apply also to the world-wide television services.

## Terms of Reference

The Chairman introduced Mr. W. Rambal of the International Standards Organisation Secretariat, Geneva, who was present to assist the Committee on any procedural difficulties that might arise, and then submitted the agenda and terms of reference for approval. After considerable discussion the following terms of reference for the committee's present and future work were approved :—

“ The Committee shall formulate definitions, dimensions, methods of measurement and test and performance characteristics related to materials and apparatus used in silent and sound motion picture photography, in sound recording and reproduction, in laboratory work, and also standards relating to the installation and characteristics of projection and sound reproduction. That collaboration be established with all other technical committees working on related subjects and especially with the committees working on photography and documentation.”

## Working Groups

Following a general but brief survey of the agenda, the delegates were divided into working groups to enable each item to be discussed in detail.

### *Dimensions of Raw Stock*

The working group dealing with the dimensions of raw stock, under the Chairmanship of Dr. White (U.S.), took the current American standards, which are dimensionally in accord with those of the U.K., as a basis of discussion but at the same time submitted the American proposal for a common negative and positive perforation. Little difficulty was experienced in reaching agreement on the overall dimensions of raw stock to suit low shrinkage

material and the widths of 35mm. and 16mm. stock were changed from  $34.98 \pm 0.025\text{mm.}$  and  $15.98 \pm 0.025\text{mm.}$  to  $35.00 \pm 0.05\text{mm.}$  and  $16.00 \pm 0.05\text{mm.}$  respectively. Other dimensions were slightly amended, the most important of which was that giving the maximum misalignment of perforations. Hitherto the misalignment had been measured by the lead of one perforation over that on the opposite side, measured in the direction of film travel. This dimension, however, does not provide a safeguard against the torsional misalignment of the punching heads that occur in practice and consequently a new dimension has been introduced to give a maximum permissible angular displacement between any pair of perforations.

### *Sprocket Perforation*

Considerable discussion centred upon the proposal to introduce a common type of sprocket perforation. The American proposal sponsored by the S.M.P.T.E. was the retention of the existing standards for negative and positive perforations and at the same time to introduce a new specification for a common perforation which could be adopted at the choice of any manufacturers. In putting forward this proposal the S.M.P.T.E. felt it necessary to give the warning that although the proposed common perforation had the same overall dimensions as the negative perforation, positioning pins and sprocket teeth made to fit exactly the new perforation will damage the corners of negative perforations. The British view was that it was most undesirable to introduce optional or alternative standards and the proposal would very likely lead to the production of three types instead of the present two. Furthermore, no advantage would be secured and perhaps confusion might result from the adoption of a common shape of perforation but having differing pitches for negative and positive stocks. If complete uniformity could be secured it would be preferable to introduce the same as a new standard to supersede the old ones, a suitable time being allowed for the transition period during which manufacturers could change their equipment and existing stocks could be consumed. It was also

suggested that as an intermediary step a common form of perforation might be established and issued as the standard for colour film only and if experience showed that this standard was satisfactory, it could then be widened to embrace black and white negative and positive material.

The French and German delegates were more emphatic in their views and considered the establishment of a common perforation on the lines discussed by the I.S.A. Committee in 1938 should be established without further delay. The only consequence involved in the acceptance of the positive perforation was the possible alteration of the pilot claws of cameras but this alteration was very simple to carry out during the frequent maintenance overhauls needed by these appliances. They therefore proposed that a decision should be made immediately to become effective in two years' time. This proposal was not put to the vote because the American delegates stated that research and experimental work was still being carried out and they were hopeful of giving a consolidated decision in the near future.

### *Position and Dimensions of Photographic Sound Tracks*

The working group dealing with the position and dimensions of photographic sound tracks was under the Chairmanship of Dr. Leo Busch (Germany). At the opening of the discussions the French delegate submitted that the speed of projection should be increased to 25 frames per second, the reason for this submission being the convenience offered when films were being used for television broadcasting. The general view was that an established standard could not at this stage be upset by a special consideration of this nature.

The French delegate next submitted that the sound to picture displacement should be altered to  $19 \pm \frac{1}{2}$  frames in order to provide synchronisation between the sound and picture in the average review room, which in France is 25 ft. in length. The current British and American standards provide for a displacement of  $20 \pm \frac{1}{2}$  frames. After discussion it was considered desirable that synchron-



isation should be effected at a distance of 50 ft. from the screen, this being the mid-distance of auditoria of normal size. It was, therefore, agreed that the displacement between the sound track and its accompanying picture shall be  $21 \pm \frac{1}{2}$  frames.

The German delegate pointed out that America had departed from its own standard in respect of distance from the reference edge to the centre line of the sound track on 35 mm. film. The standard provided that this dimension shall be  $6.17 \pm 0.02$  mm. but this had been increased to  $6.19 \pm 0.02$  mm. and it was agreed that this latter dimension be included in the proposal for an international standard.

The French delegate in pointing out the wide use of 16 mm. projectors in French cinemas proposed that the width of sound tracks on 16 mm. films should be proportional to that on 35 mm. stock. The direct proportionality required the sound tracks to be 0.063 ins. for variable area recording and 0.83 ins. for variable density; the present standard provided for a width of  $0.60 + 0.006 - 0.001$  ins. After discussion it was agreed that the international proposal should be provided for a sound track on 16 mm. stock of  $0.80 + 0.004 - 0.001$  ins. This decision clarifies the position as far as normal negative/positive processes are concerned but still presents difficulties with reversal prints. Many studios adhere to a width of 0.085 ins. for Kodachrome and the Bell-Howell J. Printer provides for a width of sound track of  $0.95 \pm 0.001$  ins. Consequently there is a clear margin of 0.005 on each side of the sound track and whilst this is not objectionable, providing the film is correctly positioned in a projector, in the case of careless threading or wear the quality of reproduced sound will be seriously impaired, particularly if the film is in a dirty condition. This matter, however, must be further considered at a future meeting of this Committee.

#### *Definition Test and Identification of Safety Film*

The working group appointed to consider the definition test and identification of safety film was under the Chairmanship of Dr. L. Knopp (U.K.) who reported that as a result

of impending legislation in the United Kingdom, the Home Office had requested the British Standards Institution to reconsider the British Standard of 1939. This standard closely followed the American standard of about the same date and sought to define safety film as being a material difficult to ignite, slow to burn and to contain not more than 0.36 per cent of nitrogen. The British view was that the method for the determination of ignitability and burning time required equipment that was unnecessarily elaborate and required skilled laboratory assistants to operate it. The British Standards Institution had enlisted the assistance of the Fire Research Station operating under the Department of Scientific and Industrial Research and the Fire Offices' Committee and a new test equipment had been evolved which was simple to use and gave readily what results are necessary to determine whether film was of acetate or cellulose nitrate base and it was submitted that the British Draft Specification be the basis of a proposed international standard. Demonstrations of the equipment were given.

The American delegates stated that their own specification was under consideration for re-drafting and they asked for working drawings of the British test equipment so that they could make replicas for carrying out their own tests.

The French and American delegates stressed the need for legislative purposes for an international standard. In France the I.S.A. standard of 1936, based upon the proposals at the eighth Congress of International Photography, Dresden, 1931, and adopted at the ninth Congress, Paris, 1935, had been accepted by the legislature and consequently it would be extremely difficult to make alterations to the international specification in order to incorporate the British equipment. It was proposed by Germany that the existing international standard should go forward for a period of three years and in the meantime member countries could make replicas of the British equipment to carry out their own experiments and report back to the technical Committee. This proposal was carried by a majority vote.

### *Apertures in Cameras and Projectors*

The working group dealing with apertures in cameras and projectors, met under the Chairmanship of M. Vivie (France) and agreed to accept the relative American and British standards as the basis for discussion. These specifications are in dimensional accord with one another except that various dimensions relating to the registration devices for stopping the film in either the camera or projector gate, had been deleted from the British specification. The reason for this was that these dimensions related to camera and projector design and did not form a material part of the specification dealing only with aperture dimensions and it was agreed to delete these dimensions from the proposed international standard. The French delegate stated that there was a wide use of 16 mm. film in cinematograph theatres throughout France. Newsreels, trailers and short features were invariably printed on 16 mm. stock for the sake of economy and it was desirable to make provision for the image on 16 mm. film to have the same proportion as that on the 35 mm. in order that those pictures may be projected on the same screen without alteration to mask it. It was agreed to meet the French wish by including additional dimensions for films for this particular service. Due to the different practices not only internationally but between different manufacturers in each country, it was decided to delete references to the guide edge on 8 mm. and 16 mm. specifications.

### *Magnetic Sound Recording*

A working group under the Chairmanship of Mr. Townsley (U.S.) discussed a proposed specification for magnetic sound recording. The American delegates reported that this field was being actively studied in the States and that standards for 35 mm., 17.5 mm., 16 mm. and 8 mm. film were in the process of development and although the work done by the various committees had been extensively reported, the American delegates had no definite proposals to put forward at the present time. M. Vivie stated that in France an endeavour had been made to arrive at a practical amalgamation of American and

French practice which might serve as a basis for international standardisation. This basis centred upon the track occupying the middle of the free part of 17.5 mm. strip which, in his opinion took into account the interference effect that was likely to arise from nearness to the perforations. The British view was that the time is opportune for international discussions with a view to an establishment of an international standard and it was thought that the initial step should be the determination of the position of the centre lines of the tracks, up to 3 tracks on 35 mm. film, and, to minimise acoustic distortion, that the coating should not extend up to the perforation. A minimum distance should be determined from the edge of the coating to the edge of the perforation. It was further submitted that the centre line of the track should be dimensionally located in relation to one guided edge only. A strenuous effort had been made to reconcile the various practices but agreement could not be reached. The British delegates put forward centre line distances which, with a suitable tolerance, would embrace current French and American practice but the delegates from these countries took the view that tolerances and such dimensions were undesirable and indeed the American delegates desired the discontinuance of centre line dimensions in favour of direct dimensions to physical edges and outlines. The French delegate pointed out that the dimensional standards adopted in his country accommodate both the American and German standards and suggested that the international acceptance of French practice would eliminate the difficulties which America feared.

It was not possible to reach any unanimous agreement but by a majority vote it was proposed to establish only one dimension at this stage, namely, the distance from the edge of the film to the nearest edge of the film track and this was to be  $0.236 \pm 0.002$  ins.

### *Screen Luminance*

The working group dealing with screen luminance was under the Chairmanship of Dr. L. Knopp and it was reported that the British specification was undergoing revision

in the light of recent research and progress. The British draft specification went further than the American inasmuch as screen luminance was required to be within certain limits when measured from any seat in the auditorium and proposed that the variation of illumination over the area of the screen should not exceed 70 per cent. This value, however, had not been nationally agreed because there were strong views that this diversity factor was too high. The French delegate stated that his country had adopted the standard recommended at the International Commission for Illumination in Stockholm last year; this requires a centre of screen luminance of  $35 \pm 16$  nit with a diversity factor of 75 per cent. He suggested that this should be accepted as an international standard. The German delegate favoured the French proposal but it was pointed out that the Stockholm proposal had not been ratified and there were strong national views that a diversity factor of 75 per cent was impracticable. The U.S. delegates stated that although the American standard gave closer limits than the British proposal, American opinion was not unanimous. After a lively discussion the meeting closed with a recommendation that each country should proceed with the revision of its own standard, and, with an

interchange of information it might be possible to prepare proposals for an international conference at the next international meeting. The Chairmanship of this Committee was vested in the United Kingdom.

### Programme for Future Work

In discussing the programme for future work the I.S.O. Secretariat agreed to circulate to all member countries the proposals and recommendations of the defunct I.S.A. Technical Committee 36 and it was further agreed that of the 40 proposals that had been put forward, only those that had been discussed by the working committees would be dealt with and all others withdrawn. Nevertheless, member countries of the I.S.O. were requested to submit any of their national standards which they wished to be reconsidered at an international level in the future.

At the conclusion of the Conference Dr. Knopp expressed the appreciation and thanks of the delegates for the efficient and courteous manner in which Mr. Bowritch had conducted the meeting in the capacity of its Chairman; Dr. Knopp also thanked the staff of the American Standards Association and of the Society of Motion Picture and Television Engineers for their valuable help to the delegates.

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## BRITISH STANDARDS INSTITUTION

### *Draft Code of Practice for Safety Lighting and Primary Maintained Lighting in Kinemas*

The British Standards Institution circulated for comment during August a draft Code of Practice relating to Safety Lighting and Primary Maintained Lighting in Kinemas, which has been prepared by a Joint Committee of the British Standards Institution and the Institution of Electrical Engineers.

The code relates to the Safety Lighting and primary maintained lighting in the auditorium and in other parts of the premises to which the public has access. Guidance is given respecting the characteristics of such lighting, and an indication of how the effectiveness of the lighting is influenced by such features as the architectural proportions and planning of the

building, the layout of the seating, the location of the exits, the decorations and furnishings and the brightness of the screen or stage.

The recommendations are primarily intended for new kinemas but for the most part apply equally well to the re-designing of existing installations or the adaptation of premises hitherto used for other purposes.

Those interested to see a copy of the draft with a view to commenting on it, may obtain a copy from the Secretary of the Society. Comments may be sent either direct to the British Standards Institution or to the Secretary of the Society.



## MODERN KINEMA LIGHTING

G. Robinson, A.M.I.E.E.\*

**W**HEN kinemas are built in the future or existing ones are renovated, several influences promise to make the lighting arrangements very different from the usual type of pre-war scheme. These influences which are dealt with in the appropriate sections following, include the fluorescent lamp, the forthcoming Code of Practice for safety lighting requirements, the thyatron dimmer system for fluorescent lamps, Chrysaline material and screen surround illumination.

Due to the war and subsequent building restrictions, few new kinemas have been built in Britain during the past thirteen years. There are signs of improvement, however, and with this in mind it is felt that a short review of current lighting practice in kinemas and theatres, together with a glance at future possibilities, may be of interest.

### The Fluorescent Lamp.

The fluorescent lamp has been responsible to a large degree for the marked change during the last decade in the lighting styles for well-appointed public rooms; and because of this it is felt that this influence should be discussed in some detail.

A definite trend towards indirect cornice

Manuscript received August 20, 1952.

lighting has developed since the introduction of the line source lamp, and this trend is replacing the pre-war style of ornate pendant fitting or semi-direct ceiling fitting. The modern method is to house sufficient lamps against walls or beams as inconspicuously as possible, so as to flood the ceiling with soft light. Kinemas have been affected by this development as well as high class restaurants, showrooms, stores, dance halls and city halls.

Prior to the introduction of the fluorescent lamp indirect lighting was often carried out using 15 or 25 watt filament lamps at 6-inch centres, or architectural filament lamps loaded to approximately 35 watts per foot run. The efficiency of either system in terms of illumination provided per kilowatt consumed is very low.

The importance of this aspect is appreciated when one considers that the "Business All-In" lighting tariff charged by The London Electricity Board is £3 15s. 0d. fixed quarterly charge per kVA. installed, plus 1d. per unit consumed. Table I shows the efficiencies and other data appertaining to the main types of electric illuminants so that running costs may be compared.

Table I

Type of Illuminant	Lamp Watts/ ft. run of cornice	Lumen Output/ft. average thro' life	Brightness of source, Candles/ sq. ins.	Overall Efficiency of lamp plus control gear in lumens/watt
25w. Pearl G.L.S. lamps at 6-in. Centres	50	412	24	8.2
White opal Architectural lamp ... ..	35	175	1.5	5
4-ft. Warm White Hot Cathode lamp ...	10	440	2.7	33.9
4-ft. Mellow Hot Cathode lamp ... ..	10	300	1.7	23
Warm White Cold Cathode lamp at 120 m.A. ... ..	8	250	1.5	26.5
Combination of Ivory (120 m.A.) and Gold (60 m.A.) Cold Cathode lamps...	14.5	336	1.4 and .82 respectively	19

\* The General Electric Co. Ltd.



(Courtesy : Claude General (Neon Lights) Ltd.)

Fig. 1.

extent on the brightness of adjacent displays. In a town area with well lighted shops in the vicinity it may be advisable to have an illumination under the canopy in the region of 30 lumens/sq. ft. Fig. 1 shows the exterior of the Empire Theatre, London. The central display above the canopy is an interchangeable programme sign. The feature is framed by fluted glazed columns which incorporate red, green and blue tubing on separately switched circuits. The high level of illumination is required not only to attract attention but also to present a pleasing appearance, and in addition to facilitate the appraisal of "stills." It must be borne in mind, however, that there is a risk of accidents happening to

patrons emerging from a brilliantly lighted area on to a badly lighted pavement and road, due to the length of time required for the eye to become dark-adapted. Above all, glare due to exposed high brightness sources should be avoided.

Floodlighting the exterior of the kinema can produce very attractive results, and coloured floodlighting can be utilised to emphasise any characteristic colour of the walls. Usually floodlighting is restricted to two close off-set floodlights mounted above the canopy.

A neon sign advertising the name of the kinema also assists in producing sufficient eye attraction.

**The Foyer, Lounge and Stairways**

It is essential that the foyer should be well-lighted and cheerful-looking, but as it is in an intermediary position to the canopy and auditorium the value of illumination should be adjusted accordingly ; a value of 7 lumens/sq. ft., would be very satisfactory. The architectural design and furnishings of foyers and indeed all public areas of kinemas have in the past set a very high standard in taste and comfort, and good lighting design of the

### The Canopy and Exterior.

In considering the general lighting problems in kinemas it is convenient to consider the principal areas as being the canopy and exterior, the foyers, lounges, stairways, etc., the auditorium and the proscenium.

A high level of illumination is desirable for canopy lighting, the level depending to some



period was integrated with this. The latter has been largely due to the very early co-operation between architects and lighting engineers. The modern tendency to build-in fluorescent cove lighting has already been stressed, and the foyer and lounge are areas where this practice can be applied successfully to obtain soft and even lighting. A combination of ivory and gold cold cathode tubing can be installed to suit any shape of cove and produces a pleasant warm light which has good colour rendering properties, and at the same time is flattering to complexions.

Fig. 2 shows a typical foyer, featuring indirect lighting on the ceiling and in the alcoves.

Alternatively a combination of semi-direct fittings producing well-diffused lighting and cove lighting is very effective, and in this connection a new plastic material with unique properties was introduced at the Festival of Britain Exhibition. "Chrysaline" is a translucent substance with good transmission and diffusing properties which can be sprayed on to a wire former to produce a multitude of shapes. It may be that the impact of the innovation will in some cases foster a return to the pre-war practice of using large fittings in original designs. When a kinema is to be relighted in a modern style it would be as well to consider the use of lighting fittings designed in the contemporary style.

Sales kiosks in the foyer should be brightly lighted from above by fittings obscured from view by a pelmet or other means. This method helps to pro-

duce the effect of a small open shop window with the assistant sitting within easy reach of the goods on display.

An illumination of 5 lumens/sq. ft. is sufficient for stairways and corridors, and this value is in keeping with the desirable lowering in levels of illumination from exterior to auditorium. For exit passages a considerably lower level of illumination is permissible. The type of fitting employed should preferably be in keeping with that used in the foyer, and careful attention should be given to providing even illumination.

Safety lighting fed from a separate supply must be installed in all public parts of the kinema and this may be achieved in an inconspicuous yet effective manner.

### The Auditorium

Auditorium lighting may be divided into three groups :

- (a) Safety lighting ;
- (b) Primary maintained lighting ;
- (c) General lighting.

### *Safety Lighting*

A code of practice is now being drawn up by a Joint Committee of the Institution of



Fig. 2



Electrical Engineers and the British Standards Institution, dealing with safety lighting and primary maintained lighting in cinemas. The Cinematograph Regulations (1950) require that the auditorium and all exits to the outside of the building should be adequately lighted during the whole time that the public are present, to enable members of the audience to leave easily. In the event of a failure of the main electricity supply this "safety lighting" must be available immediately and therefore it is normally provided from a battery system, which may be of the trickle-charged or floating type, or

In this case, the criterion of visibility was agreed on as the discernment of seats, gangways and exits to a degree adequate for safe movement. Observers were required to view for three minutes a screen showing a film selected for high brightness, after which the film was cut off and the time taken to reach an adequate state of dark adaptation was measured. An interesting point is that reflected light from the screen increases the auditorium illumination, and this also influences the time taken for the eye to reach a state of dark adaptation after the film is cut off. Weston and Stroud reported in 1939

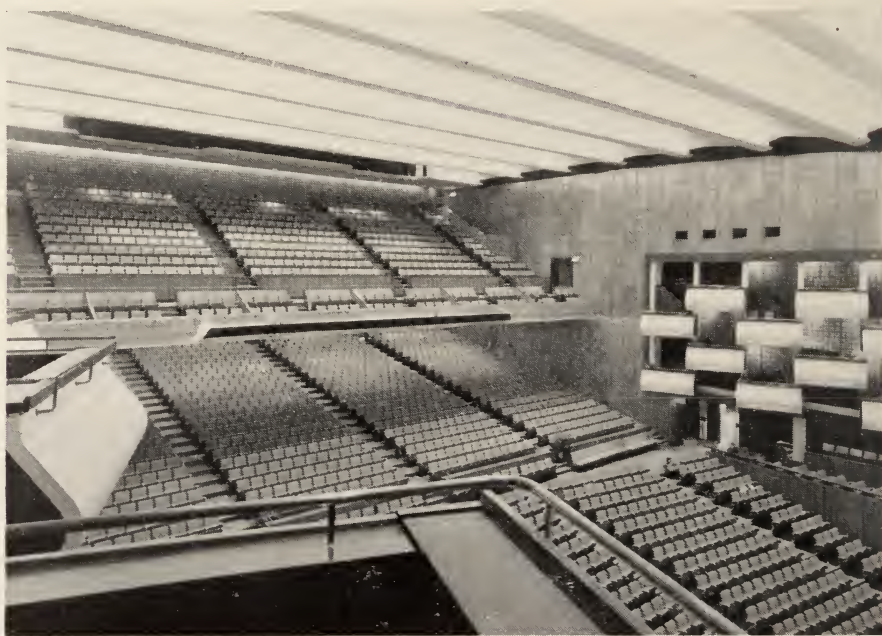


Fig. 3

from a private supply. It is required that the safety lighting system should be electrically separate from the primary fed lighting, and should be always "on" while the public are present.

An earlier study made by an Illuminating Engineering Society Panel led to a proposal being made that the illumination from safety lighting should be 0.0025 lumens per sq. ft.<sup>2</sup>

This level of illumination was confirmed by a later investigation which included tests made in the Tatler Theatre, London.<sup>3</sup>

a figure of 0.016 lumens/sq. ft. for this increase in auditorium illumination.

#### *Primary Maintained Lighting.*

During a performance it is considered good practice to light the auditorium with both safety lighting and primary-maintained lighting. The latter, which is fed from the main supply, is intended in the auditorium to ease movement along the aisles and among seats to enable the management to preserve order and good behaviour. In 1939 a Panel set up

by the Illuminating Engineering Society proposed a value of 0.05 lumens/sq. ft. for the maintained illumination necessary to give good visibility on entering an auditorium from daylight. At this time a screen illumination of 10 ft. candles (or lumens/sq. ft.) with no film in the gate was considered average. No deterioration in the picture was noticeable when the auditorium illumination was increased from 0.01 to 0.05 lumens/sq. ft. Strangely enough even with increased screen brightnesses to-day, the illumination provided by maintained lighting alone is usually less than 0.01 lumens/sq. ft. This figure should be higher, of course, in a News Theatre, where there is an almost continuous movement of people.

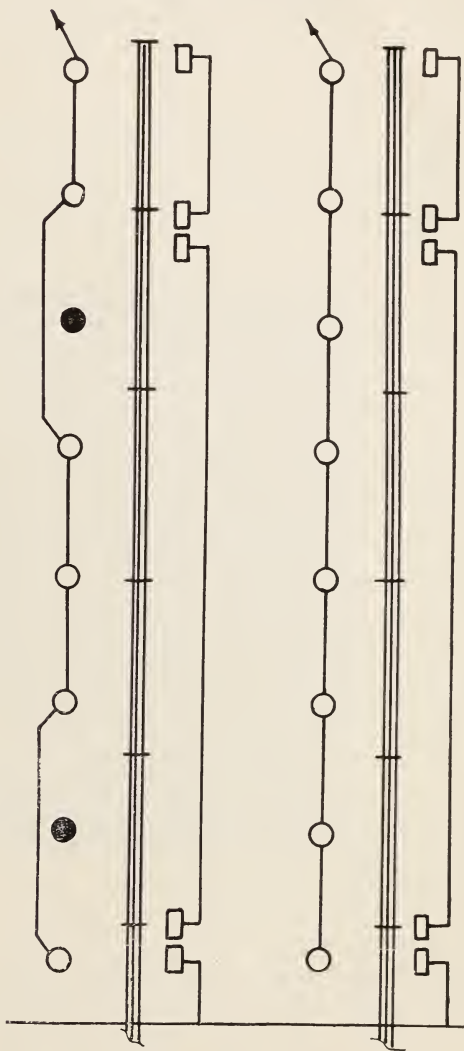
The provision of maintained lighting should be carried out so that it is unobtrusive, and while a wide diversity of illumination is tolerable, dark areas and abrupt changes in illumination should be avoided. The Royal Festival Hall is an interesting example of an installation where all maintained lighting is dimmed to a uniform brightness when the general lighting provided by cold cathode tubing is dimmed out. The maintained lighting is provided mainly from 150 recessed louvre spotlight fittings housed adjacent to nine transverse cornices concealing cold cathode tubes as shown in Fig. 3. A proportion of the 150 watt spotlights is fed from a separate D.C. supply, and constitute the bulk of the safety lighting. When "full-on," these spotlights boost the general illumination provided by the cold cathode tubing from approximately 3 lumens/sq. ft. to a total of 10-12 lumens/sq. ft., and when dimmed produce well-distributed maintained lighting.

In the event of a mains failure, a contactor automatically increases the safety lighting to approximately 3 lumens/sq. ft.

It is important that no bright sources of light should be included in the maintained lighting, as these tend to distract or impair the vision of members of the audience. Wall brackets and under-gallery fittings are offenders in this respect, and it is suggested that recessed louvre fittings with the light directed slightly towards the screen are more



ELEVATION



PLAN

## KEY

- 150-watt recessed fitting.
- as above for safety lighting.
- ||| cold cathode triple tubing.
- cold cathode transformer.

Fig. 4. Lighting arrangements for typical portion of the ceiling at the Royal Festival Hall.



satisfactory. The Telekinema on the South Bank site has this type of ceiling fitting. When planning the auditorium it is desirable that exit doors and doors leading to toilets are not so situated that their brightly illuminated signs fall within the broad field of view of the audience. Brightly illuminated clocks can also be a cause of distraction or annoyance.

### *General Lighting*

During intervals and between performances, particularly when there are large movements of people about the auditorium it is necessary to increase the illumination to a higher value, the effect being to draw back the veil on the architect's art and impress patrons with the interior furnishing and decorations. Form, balance and colour must all be conveyed correctly to the viewers and the lighting should emphasise the architectural style. It is felt that indirect lighting from plaster coves has a very big part to play in the flooding of large areas with a discreet light and pleasant effects can be obtained by relieving this soft lighting with small scintillating point sources of direct lighting with a number of decorative fittings in the contemporary style. A value of illumination in the region of 3-5 lumens/sq. ft. is suggested for general lighting, and suitable dimming systems are discussed later.

"Chrysaline," which has already been described in connection with foyer lighting, is a material which is particularly useful in replacing diffusing glass in the screening of lamps from direct view due to its non-inflammability, its high diffusion qualities and particularly to its lightness. It is felt that lighting fittings should be so constructed as to minimise any possible danger to persons below and to this end decorative "Chrysaline" fittings are intrinsically safer than any other type of fitting with comparable performance.

It is not generally known that it was originally intended to equip the Royal Festival Hall with kinematograph equipment, and the lighting arrangements were designed with this in mind. There is in fact a source of D.C. supply from special mercury arc rectifiers for the projection lanterns. A view

of the auditorium is shown in Fig. 3, and one is impressed with the streamlined effect of walls and ceilings kept free from encumbrances.

Fig. 4 shows in diagrammatic form, part of the lighting arrangements of the Royal Festival Hall.

The auditorium lighting of the Princes Theatre, Hong Kong, will be similar in some respects to the cold cathode installation in the Royal Festival Hall. This kinema is still under construction, but over 1,000 ft. of intermediate cold cathode tubing has been supplied for general lighting, all of which is arranged in cornices. There are six transverse ceiling coves and two on the under balcony ceiling. Additional tubing will be positioned above a plywood dado on either side to give upward lighting on the walls.

### **The Proscenium**

Just prior to the war interest was shown in the possibility of the proscenium having a scientific function as well as an aesthetic one. As reported by Weston and Stroud the I.E.S. Panel experimented with illuminated drapings round the screen and reached the conclusion that the visibility of picture and comfort of seeing were enhanced by illuminating the screen surround to a low brightness. An American Theatre Lighting Committee had already found that a brightness figure of 0.05 millilamberts (approximately 0.05 ft. Lamberts) on the screen surround provided comfortable viewing conditions.

War conditions prevented the development of this idea, but there is some support now for its application to relieve the contrast glare between the high screen brightness which is available to-day and its relatively dark background. Eye discomfort after watching a kinema show has been attributed in some cases to this discomfort glare.

Discomfort glare according to Petherbridge and Hopkinson "is primarily a function of the balance between the brightness and the intensity of the glare source on the one hand and the brightness of the surroundings on the other; the higher the brightness of the surroundings the less discomfort will be caused by a given glare source."<sup>4</sup>



There is a limit to the improvement obtainable and after this point the immediate surround brightness becomes itself a source of glare. Their experiments were concerned mainly with discomfort glare met with in the lighting of buildings under idealised conditions, one of these being that no particular visible task was being undertaken. Their results and analyses are useful, however, when considering discomfort glare in kinemas and it seems for instance that a gradation in brightness from the screen to the general surround is necessary.

There does not appear to be much agree-

South Bank site. A "colour surround" or "borderless screen" is projected to form an illuminated immediate surround which varies in colour and brightness with the picture.<sup>7, 8</sup> Another feature is that the stage-like setting which is generally used for screens is replaced by a screen picture frame effect. This effect is enhanced during intervals by a continuous line of light thrown towards the screen from intermediate cold cathode tubing arranged on a motorised dimmer.

Fig. 5 shows a televised picture projected on the screen of the Telekinema and framed by an illuminated surround derived from a



Fig. 5.

(Courtesy : Cinema-Television Ltd.)

ment on the degree of illumination required for the illuminated surround, but as a matter of interest it was reported last year by the International Commission on Illumination<sup>5</sup> that an American, Mr. S. K. Guth, in a paper<sup>6</sup> entitled "Surround Brightness" had established in a series of tests that the border brightness should be approximately half the square root of the average picture brightness.

Probably the best known experiment using immediate surround illumination to reduce contrast glare between screen and general surround exists at the Telekinema on the

separate projector. It is considered that the illuminated surround enhances picture definition.

It is interesting to note that television viewers were faced with a similar discomfort glare problem in the early days of television reception, and most people have overcome this by allowing a degree of ambient light as reported by Mr. J. C. H. Moss in his recent address to the Association of Optical Practitioners on the subject of television.

The more usual function of the proscenium lighting is to focus attention to the front of

the kinema where an impressive curtain with lavishly decorated wings is flooded with light, often on a colour change cycle. The advent of coloured fluorescent tubing, both hot and cold cathode, has made possible a very large reduction in kilowatt load as compared with a system using sprayed filament lamps or filament lamps using colour screens. The table below shows some comparative light output figures.

### Dimming Equipment and Technique

As the auditorium load to be dimmed may run into tens of kilowatts, the operator in the projection room requires to be able to operate the dimming system by push button control rather than by manual lever or wheel operation. In cases where stage shows are held regularly in a kinema it is necessary to have a more complicated and very flexible dimmer system for operating the special stage lighting equipment.

There are many dimming sequences which are possible besides the straight-forward method of dimming all auditorium lighting together, but in general the best effect is obtained by dimming from front to back in a wave motion, starting with the proscenium and finishing with the back of the circle. This type of wave motion dimming is employed at the Royal Festival Hall.

The technique of dimming filament lamp lighting presents little difficulty. Resistance, transducer and thyatron control are available, and the respective merits of each has to be balanced against its relative cost. Certain basic difficulties arose some years ago when it was required to dim to extinction large quantities of fluorescent lamps of either the hot or cold variety.<sup>9</sup>

The first real attempt in this country to dim a large installation of these to extinction was carried out in the House of Commons Chamber, by using filament lamp auxiliary circuits.

**Table II**  
RELATIVE EFFICIENCIES FOR COLOURED LAMPS

Type of Lamp	Approx. Lamp Efficiency in Lumens/Watts.
100-watt lamp sprayed red ... ..	0.6
100-watt lamp with red colour filter ... ..	2.5
5-ft. 80-watt red fluorescent lamp ... ..	4 at 100 hours.
Cold cathode neon red lamp ... ..	13.5 at 100 hours
100-watt lamp sprayed blue ... ..	0.25
100-watt lamp with light blue colour filter ... ..	2.4
5-ft. 80-watt blue fluorescent lamp ... ..	14 at 100 hours
Cold cathode blue lamp ... ..	16 at 100 hours
100-watt lamp sprayed green ... ..	2
100-watt lamp with light green filter ... ..	2.4
5-ft. 80-watt green fluorescent lamp ... ..	50 at 100 hours
Cold cathode green lamp ... ..	64 at 100 hours

N.B.—Similar colours produced by the various illuminants above are not necessarily equivalent in shade and saturation. Therefore direct comparison of lamps should only be made to obtain rough guidance.

Recently a thyatron dimming control has been perfected which will dim smoothly to extinction a number of fluorescent lamps wired in parallel. This system has many advantages, one of which is a big reduction in dimmer size and another that the number of cables between dimmer unit and fluorescent fittings is very much reduced.

A single unit with an output of 14 amps is available for manual control by a small rotary resistance or for remote control, and can handle up to 32 5-ft. 80w. lamps or 42 cold cathode tubes running at 120 m.A. If a margin is allowed when designing a thyatron scheme of this nature, it is possible to wire more lamps in parallel at a later date without affecting the dimming. Moreover, costs compare favourably with any equivalent system.

### Conclusion

It is necessary to emphasise that the substitution of fluorescent lamps for filament lamps leads to considerable reduction in operating costs. It is estimated for instance that a particular London kinema, with stage facilities, which has a total loading of 138 k.w., comprising approximately 80 k.w. of general lighting, 40 k.w. of stage lighting and the remainder exterior and neon lighting, would require a total load in the region of 60 k.w. to produce the same effect if fluorescent lighting were installed.

There is a further point in connection with the standard set for the general lighting for auditoriums, corridors, foyer and lounge. It is not enough to provide adequate illumination in terms of lumens per square foot. It is axiomatic that a kinema is a place of enter-

tainment, and all public parts of the building should be decorated to emphasise that this is so. A member of the public can at any time see modest furnishings and decorations and strictly functional lighting in public libraries, Post Offices and the majority of shops, but in visiting a place of entertainment he expects to feel lifted from the humdrum and treated in a luxurious manner.

It may at first seem unnecessary to apply this argument to the auditorium where the general lighting may only be required for relatively short periods. Moreover, the management are not obliged to provide any general lighting in addition to the maintained lighting, and in fact there is at least one kinema where audiences are left to sit through intervals in semi-darkness. It is a wrong policy, however, as a certain degree of atmosphere and spectacle without garishness must be cultivated in order to maintain interest during periods when the film is not showing. The kinema can never compete with the stage for sheer atmosphere, but there are certain effects which can be created with imaginative lighting which help to maintain and heighten interest. Probably the most impressive effect occurs when the house lights are dimmed slowly before the performance, perhaps like a black shadow sweeping from front to back—an effect which Sinclair Lewis has called “the magic pause, the endless second of anticipation.”

Finally, it is to be hoped that in considering kinema lighting arrangements in the future that the latest developments which have been discussed in this paper will be given due thought.

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## RESOLUTION TEST CHART OF THE MOTION PICTURE RESEARCH COUNCIL

The Motion Picture Research Council has announced the preparation of a resolution test chart designed primarily for the use of studio camera departments. When mounted in front of a 35mm. camera lens at a distance in inches equivalent to the focal length of the lens in millimetres, its image exactly fills a standard 35mm. aperture (American Standard Z22.59—1947). Resolution test figures in key positions over the field will then indicate limits of resolution directly in lines per mm. Other test patterns give qualitative indications of serious aberrations or other lens defects while carefully designed focus figures at the centre and each corner

assist in studies involving depth of focus and curvature of field.

Although designed primarily for use with 35mm. camera lenses, the chart may be used satisfactorily with any photographic lens. It may not fill the field at a specified distance, but simple conversions of the indicated scale units can be used without difficulty. An illustration of the chart is included. It is printed on white card and has an overall dimension of approximately 16 ins. by 22 ins.

Reprinted from the *Journal of the Society of Motion Picture and Television Engineers*, Vol. 58, No. 6, June, 1952.

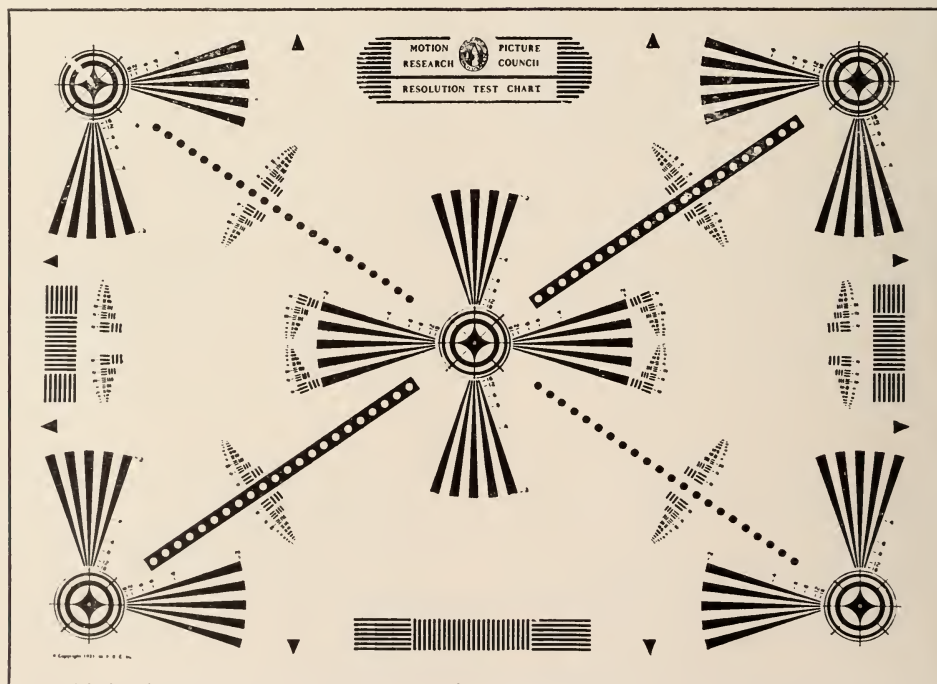


Fig. 1. Motion Picture Research Council resolution test chart.

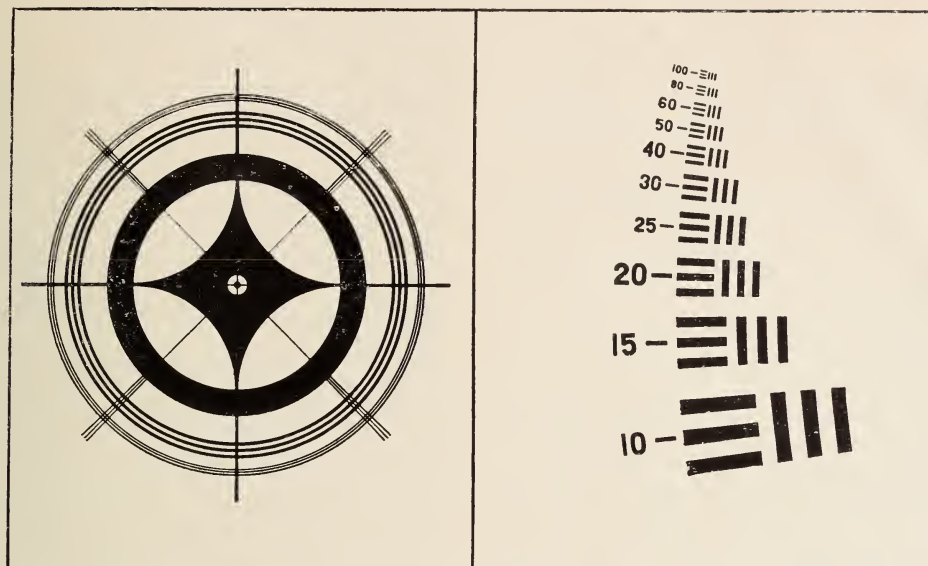


Fig. 2. Enlargements of sections of the chart.

### THE LIBRARY



A general view of part of the Library located at 164 Shaftesbury Avenue, W.C.2. It is open to members from 9.30 a.m. to 5.30 p.m. from Monday to Friday.



## BOOK REVIEWS

*Books reviewed may be seen in the Society's Library*

**KINOGERÄTE-TECHNIK.** *Dr.-Ing. H. Weise, Akademische Verlagsgesellschaft, Geest & Portig K.-G., Leipzig, C.I. Germany. pp. 364, pl. 16 (in German).*

This is a very comprehensive book and has been written in the form of an encyclopedia on film technique. The volume under review, Part I, deals with 16 mm., 9.5 mm. and 8 mm. film cameras and projectors although the data published in it applies to all types of film and cinematograph equipment.

The object of the book is to present the equipment designer and manufacturer with numerous details for the construction of this type of apparatus but, nevertheless, the book is equally suitable for those who have to use the apparatus as well as for dealers and agents handling projection equipment.

The book is very detailed and begins with a review of the principles of vision and hearing and the optical illusions used in cinematography. Projection on to the screen, the influence and design of flicker blades and the question of illumination is dealt with extensively. The author goes on to explain the action of Maltese crosses, claw movements and dog beaters, specialised technical and mechanical data being given for sub-standard film cameras, spools, different types of cassettes and motors.

The projection of film is dealt with and the different problems of take-up, gear-friction, and gate design are discussed. Various types of spring and electric motors are described and the methods connected with them to obtain constant speed are reviewed. Details regarding lenses and apertures are tabulated and the importance of film footage counters is stressed whilst illustrations of various types of equipment already on the market are included in the book.

In addition to all the technical data there is a very extensive bibliography dealing mostly with German publications but there are other references such as to the *Journal of the S.M.P. & T.E.*

*Kinogerätetechnik* is a very interesting and comprehensive book and well worth the reading by all serious technicians and designers in the industry and it is to be regretted that only an edition in the German language is available as yet.

O. K. KOLB:

**FILM AND ITS TECHNIQUES.** *R. Spottiswoode (Member), Faber & Faber, Ltd., pp. 516, 42s.*

Despite an unpretentious cover, this book contains a wealth of both theoretical and practical information on the subject of film-making.

Mr. Spottiswoode draws on his experience in the documentary field to present a well-written account of the mechanics and aesthetics of documentary film-production. His excursions into the fields of animation and stereoscopy are doubtless based on experiences gained while he supervised the production

and exhibition of stereo films at the Festival of Britain Telekinema in 1951. He does not cover the field of feature film production as such, and probably for this reason omits reference to economic aspects of film production, besides some of the latest technical facilities now available in major studios. He does full justice, however, to 16 mm. technique, and although this is considered from the professional angle, the problems of the amateur are not overlooked.

I found this book rather heavy going unless taken in small portions. The style is serious and somewhat lacking in humour. Treated as a work of reference, however, it should rank as a welcome addition to the literature. The scope of the book extends from script to screen and contains an extensive glossary of terms used in film-making.

An interesting chapter on possible future developments leads the reader on to rather treacherous ground in the author's appraisal of the use of television cameras in film studios. This is a subject which has not yet been treated dispassionately. Mr. Spottiswoode would render the film industry a service by treating this subject in a future edition with more of the objectivity which characterises the rest of this excellent book.

ROBERT L. HOULT.

**MANUAL OF NARROW-GAUGE CINEMATOGRAPHY.** *Arthur Pereira, F.R.P.S. (Member), Fountain Press, Ltd., pp. 514, 27s. 6d.*

This book is a revised and enlarged edition of "The Manual of Sub-Standard Cinematography," published in 1949 which was, quite rightly, very well reviewed. The recent publication has lost none of the value of its predecessor and is, in fact, an improvement in a number of respects.

The book is divided into three parts, which is rather unfortunate because it does nothing more than draw attention to the difficulty of grouping the art of cinematography under three distinct headings.

Part one is headed "The Technique" and covers film stock, the camera, photometry and sensitometry, exposure, colour, and then, although rather out of place, stereoscopic relief on projection. This is followed by studio lighting, sound-recording, and finally back to the camera with a section on microscopy, photomicrography and other forms of scientific cinematography.

Part two, headed "Artistic Realisation" deals with the theme, the script, shooting, special effects, editing, titles and finally with a section on animated cartoons.

Part three "The Laboratory" deals only for a third of its length with laboratory matters and then goes on to the projector, projection, and finally music for silent films which seems to have little connection with the laboratory.

How long one can go on adding to an existing publication so as to bring it up to date remains to be



seen, but it would appear that it is better to pull the whole work to pieces and then reassemble it afresh, completely rewriting sections where necessary. At the same time advantage could be taken when reassembling, to omit unimportant and irrelevant sections. For example, it may be interesting, or even amusing to know that a French artisan made a cartoon film by drawing each picture individually direct on to the film. It is, however, not of great technical import.

Apart from these criticisms, which are of minor importance because any section can be found quite easily by reference to the index, the whole publication is a workmanlike and fairly comprehensive piece of work. Naturally, certain subjects are not referred to in full, and some specialists will complain that certain technical processes or methods are only dealt with in general terms. This is unavoidable in a book which endeavours to cover such a large field. There is no doubt however that particularly for the student, this book can be of invaluable assistance, and in passing, it can be mentioned that there should be students in both the amateur and professional fields.

H. S. HIND.

#### TELEVISION IN THE KINEMA

A Course of Study designed to instruct projectionists and technicians in the principles of Television Broadcasting and Large Screen Television reproduction has been arranged to take place in Birmingham, Leeds and Liverpool. The course, consisting of four

#### A. CORNWELL-CLYNE

It is greatly regretted that the name of Major A. Cornwell-Clyne was mis-spelt in the new edition of the Library Catalogue. The error is particularly unfortunate since almost the whole of the valuable collection of literature on colour in our Library—notably those volumes dealing with the history of colour reproduction—was donated by Major Cornwell-Clyne.

#### PERSONAL NEWS OF MEMBERS

*Members are urged to keep their fellow members informed of their activities through the medium of "British Kinematography."*

DR. HERBERT T. KALMUS, Hon. F.B.K.S., President of Technicolor Motion Picture Corporation, will be the recipient of the Society of Motion Picture and Television Engineers' "Samuel L. Warner Memorial Award" for 1952.

lectures, will commence at the Birmingham and Midland Institute on November 18, 1952. Details concerning Leeds and Liverpool will be published later. Enrolment forms are obtainable from the Secretary, 164 Shaftesbury Avenue, London, W.C.2.

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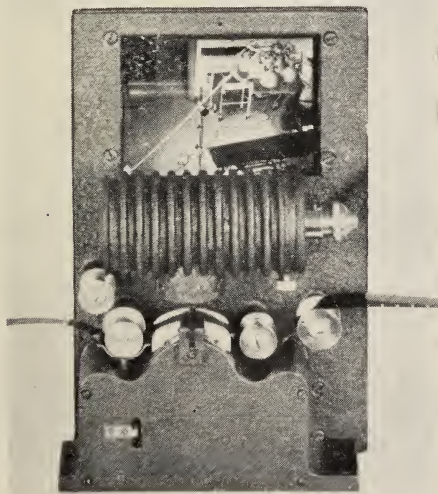
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## THE COUNCIL

*Summary of the meeting held on Wednesday, September 3, 1952, at 164 Shaftesbury Avenue, W.C. 2.*

**Present :** Mr. L. Knopp (*President*) in the Chair, and Messrs. R. E. Pulman (*Hon. Treasurer*), H. S. Hind (*Deputy Vice-President*) and G. J. Craig.

**In Attendance :** Miss J. Poynton (*Secretary*).

**Apologies for Absence :** Apologies for absence were received from the Vice-President, the Hon. Secretary, the Past-President, and Messrs. F. S. Hawkins, N. Leevers, S. A. Stevens and I. D. Wratten.

### COMMITTEE REPORTS

*Membership Committee :* — The following are elected :

John Yeomans (Student), 14 Seaforth Gardens, London, N.21.

Pietro Portalupi (Member), Lux Film, Via Po 36, Rome, Italy.

Giulio Monteleoni (Member), Ferrania, Ltd., Via Crispi 10, Rome, Italy.

Franco Galliano (Member), Istituto Nazionale L.U.C.E., Via S. Susanna 17, Rome, Italy.

Enzo Cambi (Member), Cinecitta Studios, Cinecitta, Rome, Italy.

Walter Derrick Kemp (Member), High-Definition Films, Ltd., 25 Catherine Street, London, W.C.2.

Michael McCarthy (Member), Film Producers' Guild, Ltd., Upper St. Martin's Lane, London, W.C.2.

The resignations of six Members and five Associates and the death of one Member were noted with regret.

*Report Received and adopted.*

*Education Committee.*—The large number of entrants for the Course on Colour Kinematography, which commenced on October 6, has caused a second course to be arranged similar to the first. Course II, commencing on October 13, will take place at Ealing Studios on Monday evenings at 8 p.m.

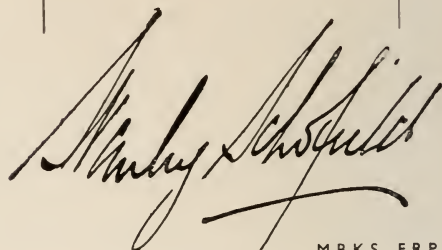
A Course on Television in the Kinema will take place in Birmingham, Leeds and Liverpool and commence on November 18, 1952, and January 13 and February 10, 1953, respectively.

*Report received and adopted.*

*16mm. Film Division.*—The alteration in the title of the Division some time ago has not changed the scope of its activities. The Division is concerned with the professional aspects of all gauges of sub-standard film and film strip.

*Report received and adopted.*

The proceedings then terminated.



M.B.K.S., F.R.P.S

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# BRITISH KINEMATOGRAPHY

VOLUME 21 No. 5

HON. TECHNICAL EDITOR :  
R. J. T. BROWN, D.S.C., B.Sc. (Fellow)

NOVEMBER, 1952

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## THE AMERICAN DRIVE-IN THEATRE

THE first large screen television programme in a Drive-In Theatre recently took place in America. It marks a milestone in the progress of entertainment of this kind.

The first "Drive-In" opened in about 1933, though it was not until 1947 that the steady but comparatively slow progress became a flood. To-day, there are more than 3,000 theatres of this type catering for over 300 million patrons annually.

The reasons for the popularity of presentations of this kind are well-known, and whilst the climate and other adverse factors prevent the appearance of similar theatres in this country, there is much to be learned concerning the technique applied and the equipment designed.

The technical problems of "Drive-In" operation

are great, and deserve the closest attention from technicians. The most difficult problem is the provision of acceptable screen brightness for a picture of over 2,500 square feet. It is significant that in spite of the special equipment which has been designed, including projector-arc lamps and a 4-inch diameter long focus lens, the Society of Motion Picture and Television Engineers has seen fit to exclude such operation from the American Standard for Screen Brightness. Problems of gate heat and film temperature have resulted in some novel forms of cooling both for the mechanism and for the film itself.

On the sound-reproduction side, the network required to feed over 1,000 individual in-car speakers and the provision of the necessary power output have created new techniques of considerable interest.

R. E. PULMAN.

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## LECTURE PROGRAMME — SPRING 1953

Meetings will take place at the Gaumont-British Theatre, Film House, Wardour Street, London, W.1. The evening meetings will commence at 7.15 p.m., and the Sunday meeting at 11 a.m.

### SOCIETY MEETINGS

- January 7 ... "Films and their Story," by CECIL M. HEPWORTH, Hon. F.R.P.S., Hon. F.B.K.S.  
 February 4 ... "Production Techniques in the Making of Educational Films," by FRANK A. HOARE, M.B.K.S.  
 March 4... ... "Modern Technique in Post Synchronisation," by W. De LANE LEA, M.B.K.S.

### 16 mm. FILM DIVISION

- January 14 ... "Modern Tendencies in 16 mm. Projector Design," by C. B. WATKINSON, M.B.K.S.  
 March 11 ... "Unusual Achievements in 16 mm. Film Production," by NORMAN S. MACQUEEN, F.R.P.S., F.R.M.S.

Three programmes of outstanding 16 mm. film productions are arranged to take place on January 21, February 25 and March 18. Admission is by ticket only, obtainable in advance from the Secretary.

### THEATRE DIVISION

- February 8 ... "Practical Problems in the Projection Room," introduced by JOHN PARSONS.  
 March 17 ... "The Production and Distribution of Trailers," by ESTER HARRIS and ARNOLD WILLIAMS.

### FILM PRODUCTION DIVISION

- February 18 ... "Process Projection in Colour," a symposium by R. L. HOULT, A.R.P.S., M.B.K.S., M. E. HARPER and C. D. STAFFELL.  
 April 15 ... "Eastman Colour Negative and Colour Print Films," by G. J. CRAIG, O.B.E., F.B.K.S.

### TELEVISION DIVISION

- January 28 ... "The Use of Film in Television Production," by IAN ATKINS.  
 March 25 ... "The Application of Television for Underwater Use," by G. T. SYMINTON.

## TELEVISION ADVANCES IN THE FILM INDUSTRY

*A symposium presented to a meeting of the Television Division on September 24, 1952.*

### CONSIDERATIONS AFFECTING THE DESIGN OF TELEVISION CAMERAS

G. C. Newton \*

IN 1936 this country inaugurated the first public high-definition television service in the world, but it is perhaps surprising to recall that wartime restriction of effort in the entertainment field has reduced our operational experience of this medium to less than a decade. Nevertheless, during this time television has become firmly established; so firmly indeed, that a distinct new art form has emerged and a new branch of industry has been born. This rapid realisation of the potentialities of the medium is one result of a happy liaison which exists between user and designer, that is between those who originate our television programmes and the development engineers of the electronic industry. An illustration of this is afforded by the television camera: pick-up tubes with improved operating characteristics have gradually been developed by laboratories. These tubes have offered new facilities for programme production, and in turn have demanded increased flexibility from the camera, particularly in its optical and mechanical features.

In this short paper it is proposed to examine a few operational peculiarities of television and to outline some of the solutions which camera designers have adopted to meet present day requirements. It is not intended to make more than a passing reference to the actual pick-up tubes or to the associated electronic circuits because these have been fully treated elsewhere. Furthermore, the relative advantages of available types of camera tube can only be fairly appraised after

a comprehensive examination of their evolution and of their behaviour under varied conditions of use.

#### The Emitron Pick-up Tube

Early television cameras were rudimentary enclosures of the tube with necessary amplifiers for the first stages of picture signal; the optical requirements were then satisfied by a single objective. In this country the pick-up tube for cameras was an Emitron, fundamentally similar to its contemporary the Iconoscope, and this tube—the “grand old man” of television—is still in use throughout the world to-day. It is of the charge-storage type with a high-velocity scanning beam, and has a target diagonal of about six inches. This latter feature limits the versatility of a camera because it restricts the minimum focal length and maximum aperture of lenses which can be employed. Modern cameras are hardly affected by such limitations because such tubes as the Super Emitron, Photicon, Image Orthicon, and the C.P.S. Emitron show marked improvements in sensitivity and have targets of the order of two inches diagonal which permit the use of more compact and comprehensive lens equipment.

#### The Present Day Camera

By contrast with its predecessors, the present day camera has a turret of lenses which is interchangeable with a zoom lens, and a focusing mechanism whose range and

\* E.M.I. Research Laboratories, Ltd.

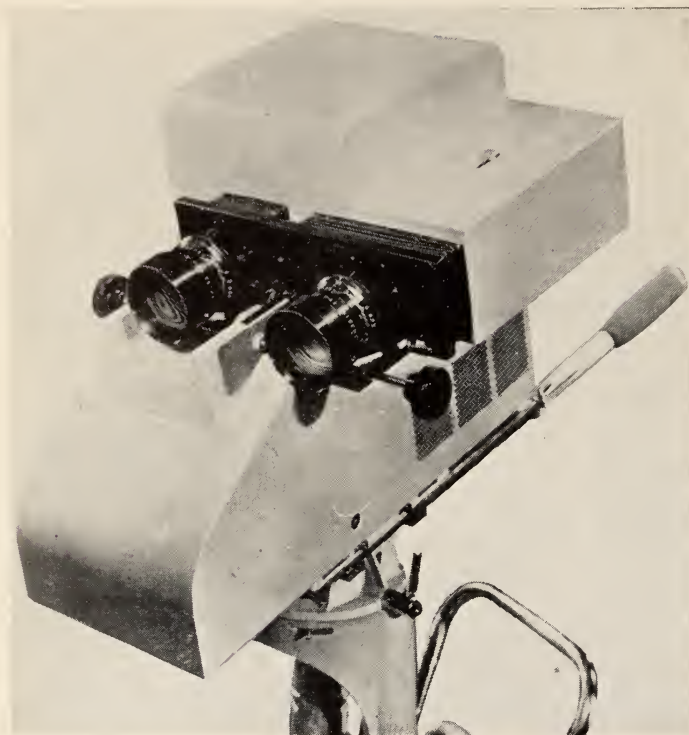


Fig. 1.

*Emitron camera with optical viewfinder employing a matched pair of lenses. (1937).*

rate of movement is variable to suit the focal length of the lens in use. In addition, there are incorporated such features as inbuilt neutral filters to cope with a range of object intensities as great as that accepted by the human eye, remote indicating iris diaphragms, and a viewfinder which is virtually a miniature high quality television receiver. Controls for many and in some cases all of these functions have been motorised, as have been the pan- and tilt-motions of the tripod head, and the elevating and traversing movements of the camera crane. It is now feasible, and occasionally eminently desirable, for the cameraman to exercise full control and yet be situated far from the camera position. The advantages of such an arrangement are evident when one remembers that the television camera, unlike its cinematograph counterpart, continues silently to record an image for considerable periods without film reloading or similar attention. Additionally, an unaccompanied camera allows reductions in the size and bulk of a camera crane and it offers

possibilities of camera viewpoints which may be uncomfortable, if not positively unapproachable, for an operator.

To those familiar with the motion picture camera it may appear that this specification is over-elaborate but the conditions of use in television broadcasting are unique, and this complexity is to a certain extent justified. For example, there may be during a television production four or more cameras working in a single studio. Here may be erected a number of sets and the producer is able to cut, fade, super-impose, mix or wipe from camera to camera and set to set, or equally well from camera to camera on the same set. Such a technique can only succeed if the cameras are mobile in all respects, if the cameraman and his crew are in direct touch by headphones with the producer, and if producer and cameraman alike are provided with a dependable indication of the outgoing picture from the camera channel.

Since each camera operates almost continuously for the duration of a production the



cameraman is working under conditions of some strain ; the effort required for the purely mechanical functions is therefore reduced to a minimum in order to promote a higher artistic standard of output without fatigue. It is for this reason that motorised controls are being used and that considerable effort has been devoted to the development of ancillaries such as the viewfinder and focusing linkage.

### The Electronic Viewfinder

It was soon established that the function of a viewfinder in the television camera is more comprehensive than in its cinematograph counterpart : in fact the operator relies on its indications to maintain focus, to check composition and depth of focus, as well as to define the extent of the transmitted picture field throughout the duration of a production.

Early viewfinders were optical and usually consisted of ganged camera and finder objectives coupled by a cam or lever linkage to reduce parallax. The demand for multi-lens turrets complicated the provision of satisfactory parallax correction and enhanced other difficulties which were already being experienced as pick-up tubes became smaller and more sensitive. In consequence, attention was directed towards the electronic

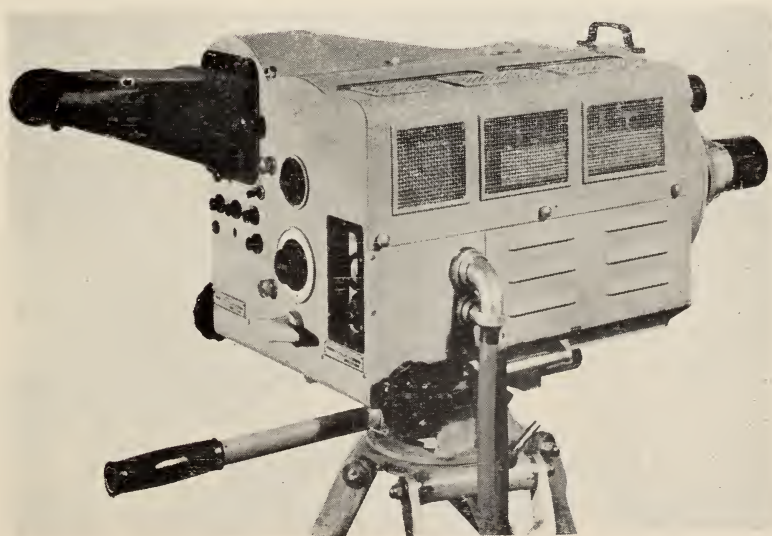
viewfinder which displays on a cathode-ray tube of four or five inches diameter, the actual picture being produced by the camera. A useful sized image of constant brightness level, which is unaffected by any changes in camera objective, etc., can thereby be maintained in a form suitable for prolonged observation. An extra high-voltage cathode-ray tube ensures a well focused scanning spot which allows high resolution of detail, and in practice it has proved possible to control optical focus of the camera, even when the resulting picture is viewed on much larger commercial receivers.

### The Optical Viewfinder

As an alternative the optical finder remains an attractive possibility, particularly because an additional view of the immediate surroundings of the picture field can be so easily presented. If a reflex optical system be adopted, some of the image forming beam which has passed through the camera objective is by-passed into the finder and, whatever lens is being used, the view given is identical in every respect to that on the photocathode of the tube. However, the ability to maintain focus requires that an image be diffused on a ground glass or similar surface to establish the image plane, whereas for viewfinding alone, an aerial image suffices with its consid-

Fig. 2.

*Camera for Midget Super-Emitron tube showing electronic viewfinder and manual controls at rear of camera for turret rotation, lens aperture, filter disc, etc. (1950).*



erably smaller light loss. In practice, a fraction as small as 5 per cent of the incident light may be deflected into a suitably designed optical system, to produce an aerial image of sufficient size and brightness for comfortable viewfinding. Some complexity of modern cameras could be avoided by providing the cameraman with an accurate optical viewfinder of this type, and relegating the responsibility for maintaining focus to an operator at the control position whose judgment would be based on observation of a large monitor.

### Focusing the Optical Image

The mechanism for focusing the optical image on to the photosensitive tube is also peculiar to television practice since rapid and accurate control must be provided for object distances between infinity and a close-up for any of the interchangeable lenses. In most current camera designs the pick-up tube is located on a carriage which moves relative to fixed objective lenses; these are mounted "parfocally," that is to say so that their image planes at infinity coincide. This tube carriage is then coupled to the focus control handle by a variable rate linkage which may be mechanical or electrical. The design problem presented by this linkage is of some magnitude since there may be a ratio of as

much as 18 to 1 in the focal lengths of lenses to be used with the camera. In such a case the depth of focus in the image space for a long focus lens at full aperture may be as much as one-third of the total focusing movement required for the lens of short focus.

### Mechanical Couplings

Amongst the mechanical couplings which have been employed are those involving cams generated to suit the focus characteristics of each of the lenses, or link mechanisms including one in which the rate of movement progressively decreases towards the infinity position which imparts a fine control to the short focus lenses whose travel is confined to this region. In addition, various electrical linkages have been proposed and some are being used; generally in such cases a small motor moves the tube into focus and is actuated by a potentiometer coupled to the focus control knob. The connection between potentiometer and motor may be a simple proportional network or more elegantly may be based on a self-balancing bridge circuit employing values of resistances which are functions of the focal length, distance of object and position of image. It is therefore possible to calibrate the focus control knob and arrange that rotation of the turret will

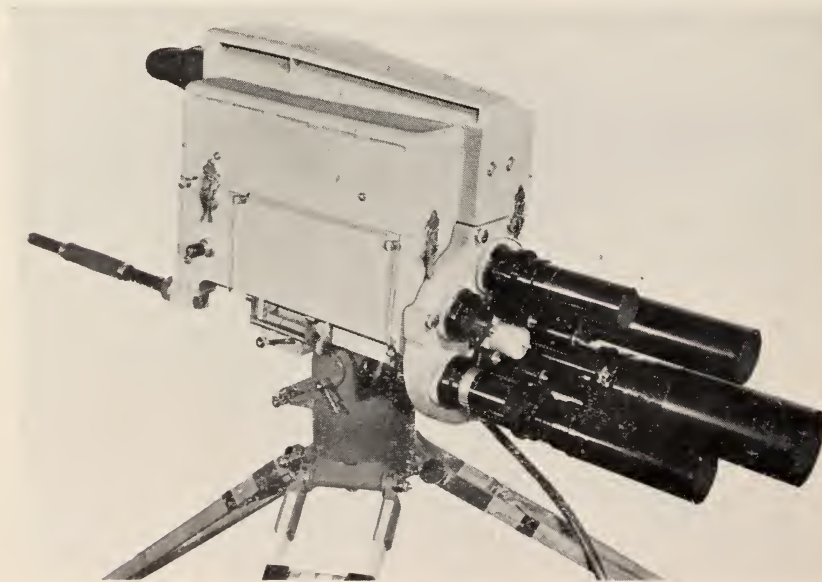


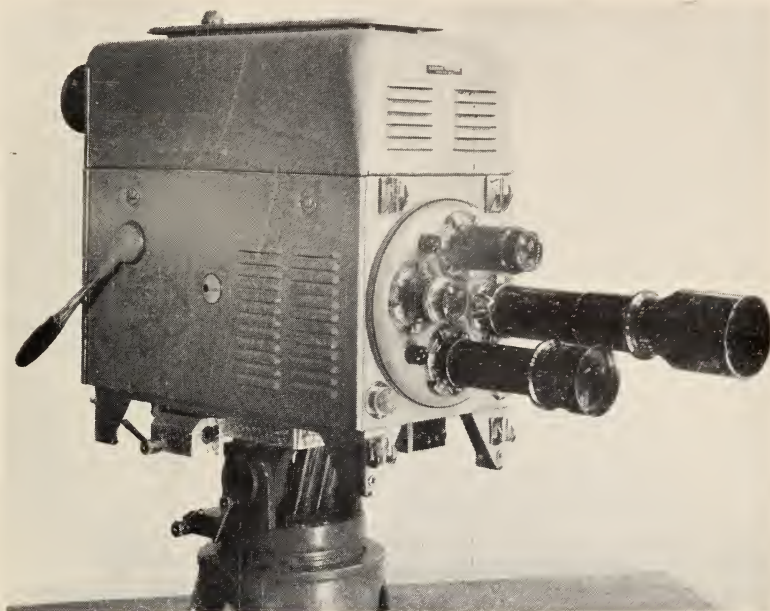
Fig. 3.

*C.P.S. Emitron camera with electronic viewfinder, six station turret, and motorised controls for lens apertures (1951).*



*Fig. 4.*

*The Marconi Mark II Image  
Orthicon television camera.*



automatically move the tube to maintain focus ; it is also particularly easy in such an installation to arrange for remote control of camera focus. However, a somewhat cynical comment on these systems which otherwise appear able to fulfil every requirement is that an alternative manual control is invariably demanded for emergency operation.

### **Image Brightness**

An important aspect of television reproduction is that both the level and the range of image brightness should be approximately matched to the optimum characteristics of the camera tube. There may be instanced a typical outside broadcast of a sporting event where variations of 1,000 to 1 in scene brightness occur during the course of play : even in the studio, directional lighting of a set may result in one camera receiving considerably more light than another having an alternative viewpoint. Under these conditions there was, and still is, a regrettable tendency to use the iris diaphragm as a brightness control, whereas its proper function is to influence the depth of field produced by the objective. Instead, neutral filters should be used to reduce the brightest highlight to that which is acceptable

to the tube, and there are modern cameras employing a filter disc between lens and camera tube for this purpose. The level of peak brightness is thus controlled. On the other hand the distribution of image brightness may also be adapted to suit the camera tube by the so-called "gamma" circuit which modifies the shape of the characteristic curve of the amplifier. In addition the tonal range can be expanded or compressed to suit that which can adequately be reproduced on a cathode-ray tube and proper use of these controls enables balanced shots of equal contrast range to be produced simultaneously under adverse lighting conditions.

### **Other Uses of Television**

The rapid development of television as an entertainment medium has, to a certain extent, overshadowed the more restrained but no less far-reaching possibilities of its use for the furtherance of other techniques. There are special purpose applications, with more strictly defined requirements, where the camera equipment can often be "tailored" to the job in hand. In film production, as an extension viewfinder or more recently, as a replacement of the cinematograph camera,



there are applications, some of which have received considerable attention in this Society. Equally well-known to you will be installations for large-screen television in cinemas or overflow meetings, or for training and educational purposes. In other directions, there is considerable interest in the surgical, medical and dental professions where some extensive experience of demonstration by television has been accumulated. In commerce and industry too, there are several installations which are used for remote observation, manipulation, or for the viewing and control of dangerous or inaccessible processes. Then there are Service and Civilian uses for observation in the air, on land or sea and under the sea.

### Need for General Purpose Camera

At present television cameras are made in relatively small numbers and there has been an endeavour to construct a general purpose instrument more or less suitable for studio, outdoor or non-entertainment applications. It is apparent that as a greater number of

cameras come into service these requirements will call for specialisation of design, and efforts are being made to rationalize production. For example circuits within the camera are being simplified and attention is being directed towards the removal of scanning amplifiers and power units to a nearby position in order to reduce the weight and bulk of the actual camera still further. Camera cables are becoming lighter and more flexible, camera mountings are being standardised, and the many problems associated with colour television are being vigorously attacked. The policy is to make available common basic components in unit form, and to incorporate only those optical, mechanical and electrical accessories demanded by the job in hand. This programme is aimed at the production of lighter, cheaper and more adaptable cameras with consequent reductions in servicing and manufacturing problems, and it will be interesting indeed to observe what developments the next few years disclose.

### DISCUSSION

W. D. KEMP: Mr. Newton mentioned that a reasonably bright visual picture would be obtained with only 5 per cent of the incoming light reflected into an optical viewfinder. That seems very low indeed, particularly if he was thinking of a tube such as the C.P.S. Emitron which doesn't need very much light. I wonder if he would clarify that.

THE AUTHOR: I would like to assure you that the value of 5 per cent, which happens to be the reflection

factor from an unsilvered glass surface, is sufficient. Under such conditions of low object illumination that observer would be fairly well dark-adapted and also he would view the aerial image quite satisfactorily through the type of terrestrial telescope optical system which is employed. There is the slight disadvantage of viewing through an eyepiece, which allows limited head movement, but adequate image brightness is maintained down to a very small aperture setting of the camera lens.

## INLAY PROCESS FOR TELEVISION PRODUCTIONS

A. M. Spooner, B.Sc., A.M.I.E.E. \*

**S**PECIAL effects, which have been used in the film industry for many years, are only now coming into use for television. Still back projection has recently become well established, and moving back projection is well on the way. Another process, known as Inlay, which was developed by the B.B.C. Designs Department and will be undergoing field trials shortly, forms the subject matter of this paper.

The Inlay process provides for television much the same result as is obtained for films

by the various forms of stationary matte. It enables a chosen area of the picture from one television camera to be "cut out" and replaced by a corresponding area of the picture from another television camera. This is done electronically with a negligible time delay, and the composite picture may be continuously viewed on a picture monitor.

Fig. 1 shows in schematic form how the process is operated. Two television cameras are used, one to view each of the scenes which are to be combined, and the two signals are

\* Formerly with the B.B.C. (Designs Dept.) now with High-Definition Films Ltd.

fed to an electronic switch of special design. This switch is capable of selecting these two signals in turn under the control of a so-called "silhouette signal." The switching action is very rapid (a small fraction of a micro-second) and it is a feature of the design of the switch that transient disturbances at the moment of switching are reduced to a minimum. This means that when the composite output is viewed on a picture monitor, the transition between an area of picture taken from camera 1 and an area taken from

uniformly-illuminated raster. The silhouette signal is generated by placing a suitably-shaped mask between the cathode-ray tube and the photocell. Where the mask obscures the spot the output of the cell is reduced to zero and the switch is arranged to select camera 2, but where the spot is unobscured the output of the cell causes the switch to change over to camera 1.

Now the shape and size of the area of the picture from, say, camera 1 which is cut out and replaced by the picture from camera 2,

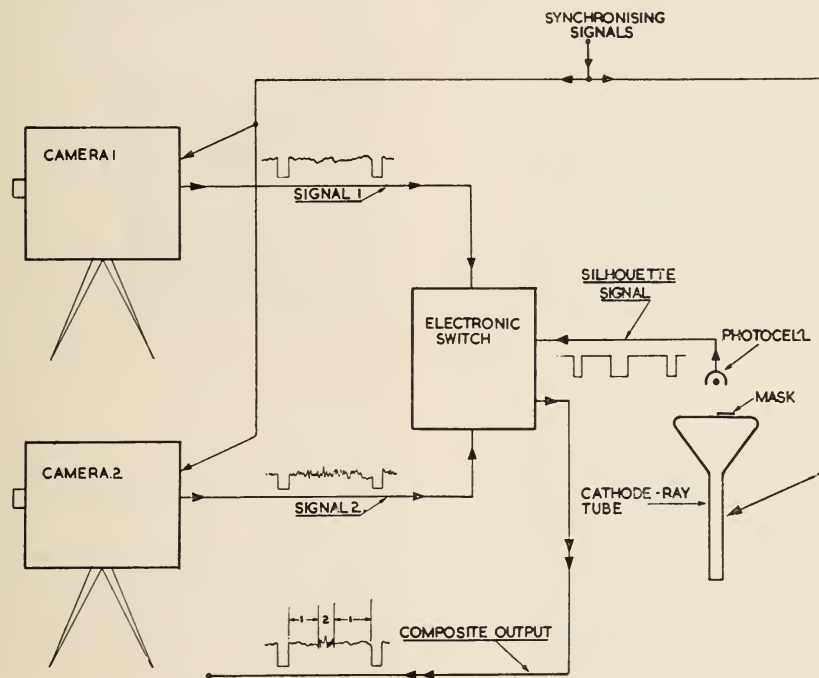


Fig. 1. Schematic form of the operation of the Inlay process.

camera 2 is very abrupt, and there is no outline between the two components. The result is very like that obtained by cutting still photographs with scissors and sticking them together to form a butt joint.

The silhouette signal which operates the switch comes from a photoelectric cell which views a cathode-ray tube. This cathode-ray tube is in effect a flying spot scanner of the type used for film scanning. The brightness of its spot is maintained at constant level except during the flyback periods when the spot is extinguished, so that on its screen appears a

correspond exactly with the shape and size of the mask placed on the cathode-ray tube face. This is so because the two cameras and the cathode-ray tube are all scanned in synchronism. Any given picture point, say the top lefthand corner, is scanned by both cameras at the same time that the bright spot of the cathode-ray tube is situated in the top left hand corner of the raster. If the mask obscures this point then the electronic switch selects camera 2, but if the spot is unobscured camera 1 is selected, and so on for all other points. It will be appreciated that the precise

size of the raster is unimportant as long as the mask is in proportion. The mark to space ratio of the silhouette pulse is, of course, in general different for each scanning line, but is nearly the same for the same lines of consecutive pictures.

### Uses of the Inlay Process

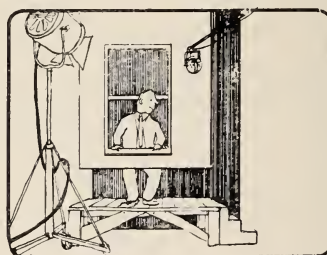
The main use of the process is scenery economy. This normally means adding additional scenery to live action taking place in the studio. Fig. 2 gives an example in which camera 1 views a photograph of a building, and camera 2 views a simple studio set-up

from film may in this way be combined with the live action. If, for example, the action had to take place on the Thames Embankment, the moving water and boats going by could be provided from a film, and the live action would then need only a very simple set. The dividing line would be arranged to follow the line of the wall. Another important case is the scene from a high building with live action on the roof and moving traffic below. A film scanner used for Inlay must be free from instability of picture position.<sup>24</sup>

Instead of putting a small area of live action into a large still or moving previously-



1.



2.



COMPOSITE SCENE

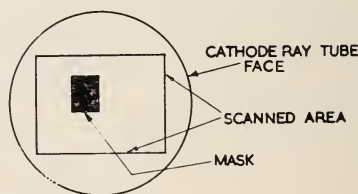


Fig. 2. An example of the use of the Inlay process.

comprising a property window with a man looking through it. The composite result showing a live actor looking out of a photographed house is obtained by placing a mask of the correct size and shape on the cathode-ray tube face.

Instead of using a television camera viewing a photograph or model to provide the additional scenery, a film scanner may be used. This provides a signal which may be used instead of that from a television camera, and has the advantage that moving scenes

recorded area, the procedure may be reversed. A studio set containing a property cinema or television screen may have any required scene inlaid over the area of the screen. (In the film industry this effect is usually obtained by back projection). Another example of using the process in this fashion is the notice or nameboard which is required by the script to be added to a building previously recorded on film. A massed meeting in Trafalgar Square, taken from a newsreel, could have the placards at the base of



Nelson's Column changed to suit the story. These gigantic placards would in reality be less than a foot wide, and would be slipped into a holder in front of a television camera. The newsreel scene would be run through a film scanner.

In the uses of Inlay so far described the aim has been to present a natural appearance on the screen. By the deliberate use of false perspective, however, another range of effects can be produced. For example, an actor may be shown as a giant or a dwarf in relation to other objects in the picture, simply by choosing an appropriate camera position. Any objects visible in the picture component containing the actor must of course be made to such a scale that they assist the illusion.

Enough examples have now been given to afford some idea of the scope of the process. It is worth emphasising that the area inlaid is decided by a fixed mask, so that if anything moves across the line of demarcation between the two component areas, it will vanish. This is useful for some effects (for example, the man looking through the window of the house) but can be awkward for others. Inlay is in a sense complementary to back projection, where the live foreground can move about in front of the projected background and so a different range of effects can be produced.

Finally, almost any sort of wipe between one scene and another may be produced using the Inlay apparatus by drawing an opaque mask of the chosen shape across the cathode-ray tube face. With the present apparatus the wipe has a sharp edge, but soft-edged wipes are possible although probably more difficult to produce reliably. Instead of moving a mask across the tube, black ink or paint can be painted, poured, or sprinkled on a sheet of celluloid placed over the tube to give another range of wipes.

### Apparatus

The apparatus which has been constructed for B.B.C. use consists of two parts: the control console containing the cathode-ray tube on which the masks are placed, and the electronic switch and its ancillaries. Each of these two parts of the equipment consists of two standard 19½-inch racks.

There are no operational controls mounted on the electronic switch racks, and so these are situated in the studio apparatus room. The operational controls are mounted on the console and this is most conveniently placed in the control room. Certain of these controls are duplicated on a small box which is normally placed directly on the vision mixer's desk.

The cathode-ray tube is mounted vertically in the control console in such a way that masks can be laid on its surface. The masks are celluloid of the type used for cartoon film making, and are punched to fit register pins mounted in the plane of the top of the tube. The opaque areas are obtained by sticking pieces of opaque paper to the celluloid, or by painting it appropriately.

Push buttons are provided for selecting the pair of cameras whose outputs are to be fed to the electronic switch, and the required alignment between cameras and the positioning of the mask can be carried out by an operator while a programme is on the air. When the time comes to use the inlaid picture, it can be selected on a push button by the vision mixer just as single cameras are selected in the normal way.

Wipes are achieved by passing miniature masks across a small image of the raster which is produced on the cathode-ray tube face. The carriage on which different shaped masks are placed as required is electrically driven. The speed, direction and moment of starting of a wipe are under the control of the vision mixer through the small control box which is placed on her desk.

### Operational Conditions

Special effects are used to save money and to obtain results difficult or impossible with normal use of the camera. The desired result is, however, only obtained at the expense of certain operational complexities.

Like back projection and travelling matte, to be successful Inlay requires pre-planning to get the correct perspective match between the two picture components. This work must be done on a drawing board, and the method will be well known to those who have had experience of special effects for films.

Another factor to which attention must be paid if a realistic effect is to be obtained is lighting. When the still photograph or moving film which is to provide the additional scenery is already in existence, the position of the key light is already established, and the set which is to provide the live action must be lit in conformity. When the additional scenery is specially shot it may be possible to choose its lighting to suit the studio scene.

The alignment necessary between the two cameras and between the mask and the images from the cameras presents certain difficulties in a television programme. First, since the programme cannot wait for these alignments to be carried out they have to be done speedily. This is largely a matter of practice. Second, while the two cameras are lined up for Inlay, they are denied to the producer for other use in the programme. Both these difficulties disappear if the programme is not being transmitted, but is instead being recorded on film, when pauses can be made between shots to make the necessary alignments.

### Comparison of Inlay with processes for films

The most important thing is that the finished result is continuously visible, and the effect of the alignments can be seen instantaneously on the picture monitor. One of

the main troubles with some matte shots is that until the film has been processed and projected, one cannot be quite certain that the desired registration has been achieved.

Another advantage is that "complementary" masks are not required, one to let through the desired part of one picture, and the other to let through the desired part of the second picture. A single mask only is required and a perfect join between the two picture components is ensured.

These advantages encourage the author to predict that more use will be made of Inlay in television than is made at present of stationary matte shots in film. A field trial of Inlay will be starting shortly, and it is hoped that this will demonstrate that the process is an economic and useful aid to television production.

### Acknowledgments

The author is indebted to the Chief Engineer of the British Broadcasting Corporation for permission to give this paper. Help and encouragement have been given freely by B.B.C. colleagues, in particular Mr. T. Worswick has interested himself in the whole programme of work and Mr. F. W. Nicholls has given his able assistance in supervising the construction of the new equipment.

### DISCUSSION

MR. MILLERSON : When one considers the general operational conditions in a television studio and, for example, the time it takes to line up a simple superimposition, then it would seem to me that any device of the inlay variety is liable to a number of errors ; the mask has to be cut to size and it might be inaccurate or difficult to position, time is taken to line it up, and correct positioning of the dividing line presents a problem. In other words, they are all operational difficulties. On the other hand with the overlay effect, which I realise is an additional facility allowed by the equipment, these difficulties are not present. I realise the electronic difficulties with threshold in the overlay circuit itself, which you haven't mentioned this evening. It seems to me that overlay has many technical and operational advantages over this particular inlay system. I wonder if you would like to comment on the reason for the concentration on the mask method, rather than the electronic method.

THE AUTHOR : I have not said anything to-night about the overlay process, so perhaps I had better say a few words in explanation.

The idea of the type of overlay referred to by Mr. Millerson is that instead of using a cathode-ray tube with a mask placed upon it to generate the silhouette signal, this signal is taken from the camera looking at the scene that is to be the foreground in the final result. For example, suppose an actor stands in front of a black background, and it is required to place that actor apparently in front of some chosen scene. Amplifying and clipping the signal representing the foreground scene, the actor, gives a silhouette signal, which can be used to work the electronic switch and thereby give the illusion of the actor appearing in front of the other scene.

This has been demonstrated in America. The main reason for its imperfection is the separation of the actor from the background in front of which he performs. The difficulty with a black background, is that parts of the actor will be as black as the background, however much light is thrown upon the actor. Those black areas will cause spurious operation of the electronic switch, and pieces of the foreground show through, which, of course, will not do. A white background can be used instead, but here



again difficulties occur. No part of the actor must be brighter than the background. Any specular reflections will again cause spurious operation of the electronic switch. So although it is true that this facility is provided on the B.B.C. equipment, it is not envisaged that it will be used in the manner that one uses back projection. It produces a rather similar effect to back projection but is not to be regarded as a substitute, although it is very useful for some trick effects.

The answer to Mr. Millerson's question is that inlay and overlay are two distinct processes and they are both needed. So far inlay has been developed to a successful state. It is hoped that further work, which is in progress, will make overlay as good as or better than back projection.

**A MEMBER :** In regard to the overlay process, I take it that experiments have been carried out with, say, a blue background or some form of coloured background to overcome the black and white difficulties. Why did they not succeed ?

**THE AUTHOR :** There is a fundamental difficulty in using the method adopted in the film industry. This is the registration of the two images. A special

camera may be used having two pick-up tubes, one sensitive to blue light and the other to yellow. The background would then be illuminated with blue light, and the actor with yellow. The tube sensitive to yellow would show the actor against an apparently black background ; the other tube, sensitive to blue, would show the actor as a silhouette. You can take the camera tube giving the silhouette signal and use that to operate the electronic switch, feeding into the switch the output from the yellow-sensitive tube to give the foreground. Another scene from a camera or from a film scanner could then be fed into the electronic switch to give the background. This is perfectly all right in theory, but the difficulty is getting good registration between the two images from the two camera tubes. Even in the film industry the registration problem is difficult, but it is soluble. With television you have to scan both the camera tubes. Scanning circuits are not absolutely linear and differences in linearity in the scanning of the two tubes makes registration difficult. Even the physical positioning of these tubes would be difficult to achieve to give good registration.

There are various ideas which it is felt, will overcome these problems in time.

## USE OF THE RADIO TALK-BACK UNIT IN TELEVISION PRODUCTIONS

R. Toombs, B.Sc. (Eng.), A.M.I.E.E., D.I.C. \*

**A**NYONE visiting a television studio for the first time is probably most impressed by the apparent state of chaos. The vastness of the studio is completely dwarfed by the number of sets and the clutter of equipment, all of which is necessary at the same time, for a single production. The complexity exists because a television production, just as a stage play, must be continuous. There can be no pause between shots, all the scenes must be preset, and a number of cameras and microphones employed to ensure rapid and smooth changes from picture to picture. In the circumstances, it may seem astounding that the home viewer ever sees a smoothly integrated vision programme, quite unaware of the apparent confusion attending its production. Further difficulties arise from the producer being relegated to the remote isolation of a control room, but these can be largely overcome by provision of adequate communication circuits.

A simple loud speaker system enables the producer to broadcast his criticisms and directions to the whole studio, but this inevitably causes an interruption. Sometimes this is desirable, but on most occasions the directions are intended for particular people such as cameramen, microphone boom operators or lighting engineers. Each of these could receive such instructions on headphones connected to spare circuits in cables already essential for other services. This is, in fact, the system adopted for normal talk-back. However, there is one man, the Studio Manager, who should be in constant touch with the producer, and he would require a trailing cable only for this talk-back circuit. Of all people, he should also be the most mobile and free from any form of tether which would hinder his negotiating the many obstacles in the studio. The need was therefore obvious for some form of wireless, or at least cableless, communication circuit to the producer.

\* The British Broadcasting Corporation



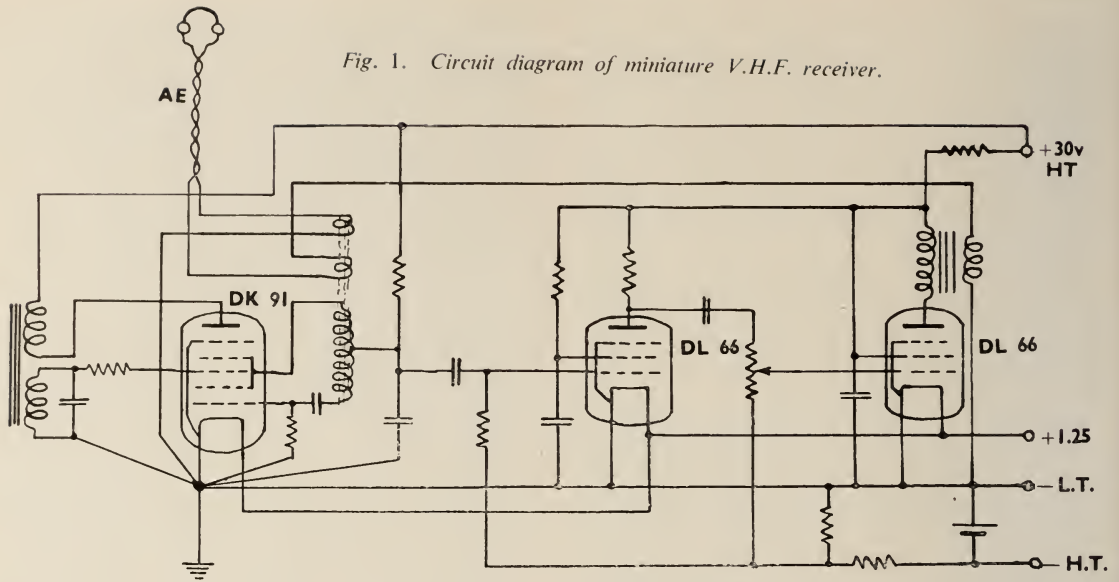


Fig. 1. Circuit diagram of miniature V.H.F. receiver.

A high power low frequency induction system seemed to offer the advantage of simplicity. All that would have been required was a high power L.F. amplifier feeding a wire loop round the studio, and a small pick-up coil attached to a pair of headphones, for the Studio Manager. However, there was a snag, and this was undesirable high power L.F. induction into the studio microphone circuits.

A straightforward radio link, therefore, seemed the better proposition and only technical details remained to be settled. The choice of carrier frequency was the most important. Preliminary tests on frequencies below 3 Mc/s gave rise to r.f. induction on the camera circuits, with consequent interference lines on the pictures. At higher carrier frequencies the trouble was avoided and it was then necessary only to obtain suitable



Fig. 2.

The miniature V.H.F. receiver connecting the Studio Manager to the talk-back circuit.

frequency allocations. With the very small radio powers involved, it is sometimes possible to operate on spot frequencies which are already allocated to high power transmitters in other districts. The B.B.C. was able to take advantage of this and use frequencies of its high power television transmitters. As a precautionary measure, no studio system was to be used on the frequency of its nearest main transmitter, so that, for example, the London Television studios would avoid the 45 Mcs. transmission band of Alexandra Palace.

A talk-back microphone, just in front of the producer (Fig. 3), is connected to a L.F. amplifier which feeds the normal cable distribution system to the various headphones points. A parallel feed is taken from the output of this amplifier, through suitable attenuation pads, to the input of the talk-back transmitter which may also be conveniently located in the studio apparatus room. Connection to the aerial is then completed by means of screened R.F. cable.

For the Studio Manager, miniature battery operated equipment was essential. At the

Fig. 3.

*Television studio control room from which the producer directs the production. The talk-back microphone is shown in front of the producer.*



So far as the equipment was concerned, there was no difficulty in obtaining apparatus for the producer's end of the links. Standard rack mounting units, of the type used for commercial communications were readily available and quite suitable for the particular application. Such transmitters, however, required a slight modification to reduce their r.f. power. A satisfactory output was found to be about  $\frac{1}{2}$  watt, when radiated from a horizontal dipole suspended from the centre of the studio roof.

time, no suitable commercial products were known, and special units were therefore designed in the B.B.C.

On account of its comparative simplicity and high sensitivity a super-regenerative circuit (Fig. 1) was chosen for the Studio Manager's receiver. The inherent A.G.C. effect of this circuit is also an advantage. Although the quality from such a receiver would not pass the B.B.C.'s standards for actual broadcasting, the intelligibility is high, and that is more important in this particular case. It was





Fig. 4.

*Miniature V.H.F. transmitter for the Studio Manager to answer the Producer*

appreciated, of course, that the regenerative characteristic might cause heterodyne whistles in other receivers on the same wavelength, but this was of little importance as only one receiver at a time would normally be used in any studio. However, by careful design, the interaction between these receivers has been kept low and the heterodyne is not objectionable until sets approach within a few feet of each other.

By use of standard deaf aid components, it has been possible to design a self-contained battery operated receiver (Fig. 2) in the space of 6 ins. by 3 ins. by 1 in. and weighing only 10 ozs., including the batteries. This can easily be slipped into a jacket pocket or, if the Studio Manager prefers to work without a coat, it can be carried in a special holster slung over the shoulder.

The tuning is preset by screw driver adjustment of an iron dust core and there is only one normal control, for output volume. The set is switched on simply by plugging in the headphones which are detachable, so that in the interest of hygiene, each Studio Manager can have his own pair. The headphones lead also serves as the receiving aerial. Access to

the interior of the receiver is readily obtained by sliding out the drawer type chassis. Valves and batteries are thus easily replaced. A "Pen" cell provides the L.T. and those of the "long life" type will operate the set for about sixteen hours. A standard 30v. deaf aid battery is used for the H.T. and lasts about twenty-five hours.

A communication circuit from producer to Studio Manager is an obvious necessity, but there are occasions when the Studio Manager would like to answer back. Usually this can be done from one of the programme microphones, but in the larger television studios the live microphone may be out of range. In any case, it could only be used during rehearsal and even that would cause an interruption. A radio reply circuit is therefore provided wherever it may be required. Once again, there is no difficulty in finding suitable equipment for the producers end where a commercial communications receiver could be used. This is of a type which is preset for a single frequency, is crystal controlled and provided with a muting circuit. The high sensitivity of such a set enables it to function satisfactorily from very weak signals so that



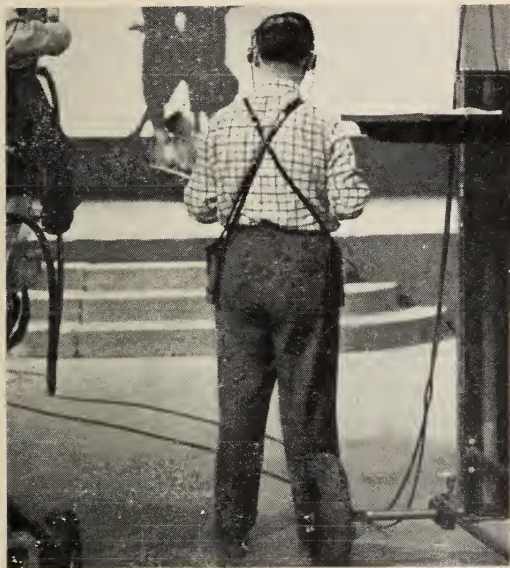
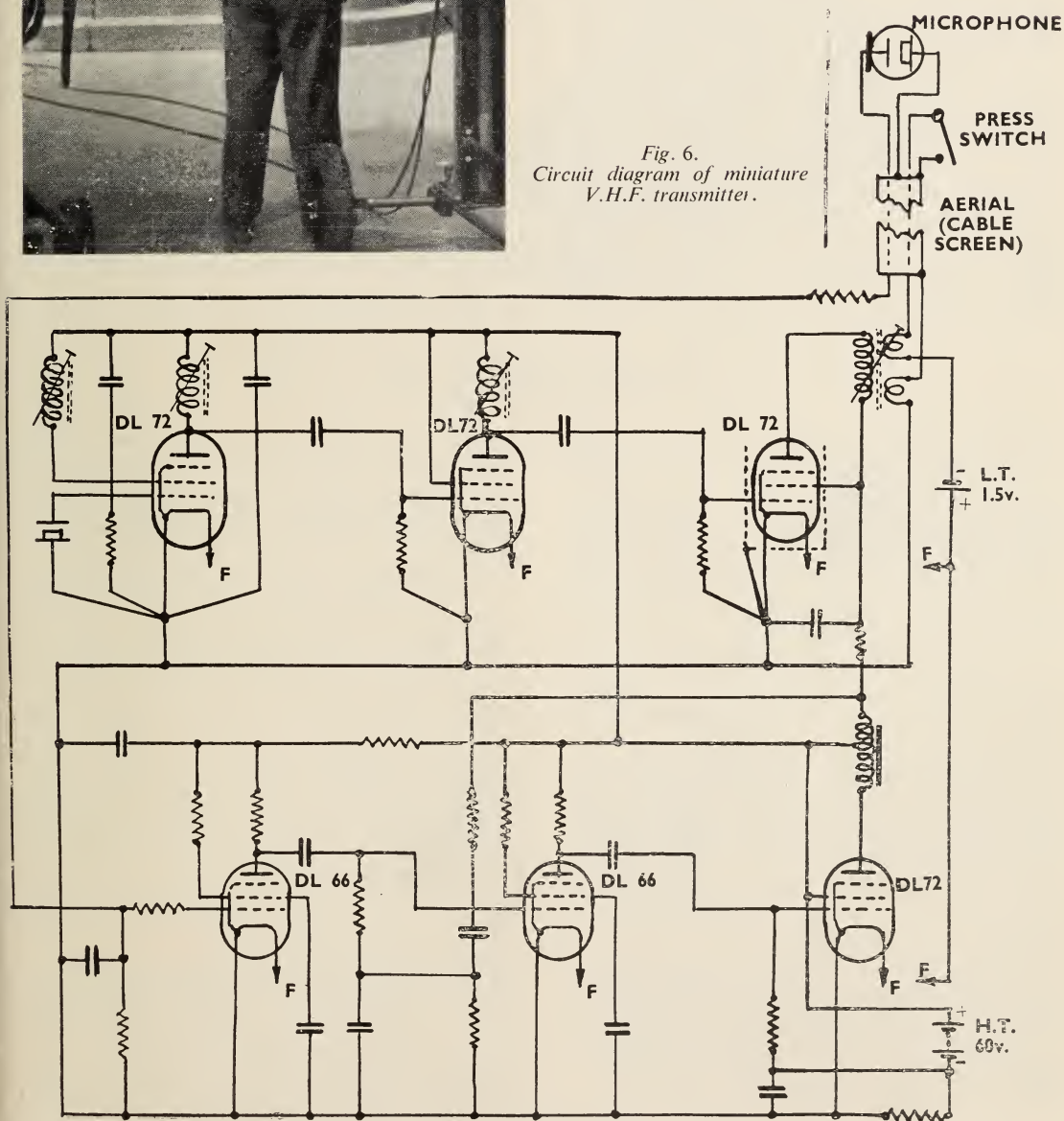


Fig. 5.

Studio Manager using the miniature V.H.F. receiver and transmitter.

Fig. 6.  
Circuit diagram of miniature  
V.H.F. transmitter.



the Studio Manager's reply transmitter need radiate only a few milliwatts of R.F. power. This unit could therefore be kept very small indeed.

It is only an inch larger than the miniature receiver. The general design is also similar, as seen in Fig. 4. In this case it is the microphone lead which is used also as the aerial. The microphone itself is a crystal type with a diaphragm and is mounted in a small handle incorporating a non-locking battery switch. The circuit is conventional, employing a crystal oscillator and doubler stage followed by another doubler and then the final power amplifier stage producing an output of 10-25 mW. This is anode modulated from a three stage amplifier with negative feedback. A "Pen" cell and deaf aid 30v. batteries are again used for the filament and H.T. supplies, respectively. The feeds are much higher than in the receiver, but this is offset by the intermittency of opera-

tion. Under these conditions one L.T. cell will provide a total operating time of about thirty minutes. One set of H.T. batteries will suffice for a total of about twelve hours under the same conditions. Little more than a whisper at a distance of 2 inches from the microphone is sufficient to provide full modulation and therefore it would be possible to use this circuit even during a live television production.

Fig. 5 shows the miniature receiver and transmitter in use at the Lime Grove Studios. From this some of the difficulties which beset the Studio Manager will be appreciated, and the advantages of radio frequency communication circuits inside a television studio will be realised.

In conclusion, I should like to express my thanks to the Chief Engineer of the British Broadcasting Corporation for permission to deliver this paper.

## THE POWER OPERATED RUN TRUCK

C. Vinten (Member)\*

TELEVISION camera technique calls for far greater mobility and for continuous following over longer times than is usual in a film studio. Such complex continuous following demands smooth unrestricted control over camera position and has resulted in the elimination of rails and the treatment of studio floors.

The Power Operated Pathfinder, an electrically driven dolly developed by W. Vinten, Ltd., and the B.B.C., represents a new advance in smoothness of operation.

The movement is controlled by the cameraman and one assistant and in spite of the good teamwork shown by the crews of the hand-operated crane, it has been found easier for the cameraman to control his footpedals than for him to make his wishes known to two colleagues.

The panning movement of both camera and cameraman is power-driven—a valuable facility in restricted sets where the turning of the whole truck or the panning of the complete crane-arm is impossible.

Steering is provided on the rear driven wheels, over which the camera is mounted; a very sharp turning circle and considerable acceleration without tyre squeak are thus available.

A very high order of silencing has been achieved by careful attention to motors, gearing and mountings generally, and the Pathfinder is noteworthy in this respect.

The following are the principal dimensions :

Length : 11 feet.

Width : 3 feet.

Weight : 15 cwt.

Lens height : 3 ft. 9 ins. to 7 ft. 9 ins.

Driving speed : 0.8 ft./sec. to 4.75 ft./sec. in seven speeds, forward and reverse.

Arm elevation speed : 0.5 ft./sec. to 0.184 ft./sec. in six speeds, up and down.

Arm rotation speed : 2.4. sec. to 9. sec. in six speeds, right and left.

Minimum turning circle : 13 feet diameter.

\* W. Vinten, Ltd.

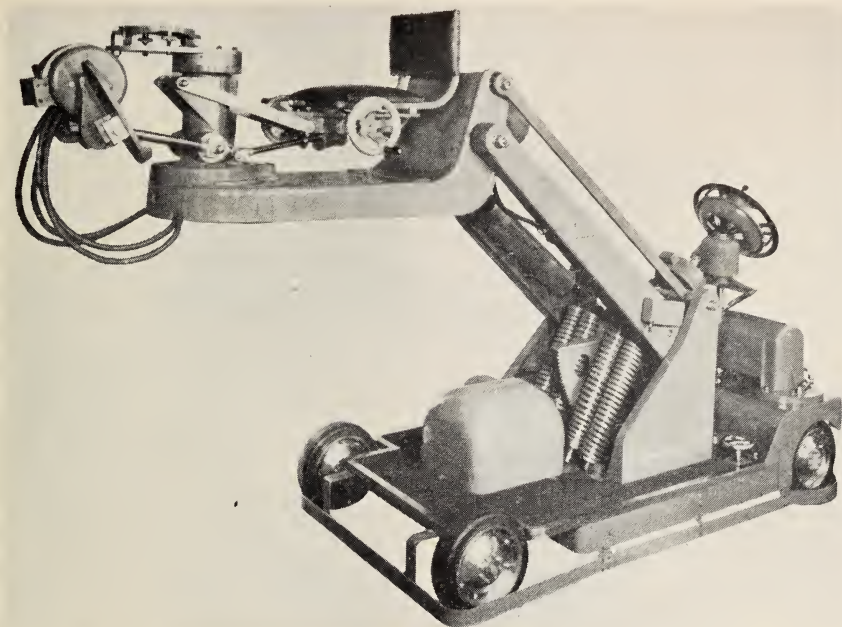


Fig. 1.

*The power operated Pathfinder.*

## DISCUSSION

N. R. PHELP : In the Power Operated Pathfinder, why does the driver have to walk instead of sitting on a seat attached to the truck ?

THE AUTHOR : It is purely a safety precaution.

You will have noticed on the demonstration film that the truck has to go forward and then backwards to a different position. If the operator is riding on the truck he is liable to run into a set.

## TELEVISION IN THE KINEMA

A Course of Study designed to instruct projectionists and technicians in the principles of television broadcasting and large screen television reproduction will commence at The Lecture Hall, City Museum, Leeds 1, on January 18, 1953. The syllabus will cover

The British Television Service : principles of the cathode-ray tube: the television receiver: the requirements and the installation and maintenance of large screen television. Enrolment forms are obtainable from The Secretary, 164 Shaftesbury Avenue, W.C..2

## COLOUR FILM PROCESSING AND COLOUR SENSITOMETRY

A Course of six lectures on the above subject will commence at the Colonial Film Unit Theatre, 21 Soho Square, W.1, on Monday, January 19, 1953.

A comparison will be drawn between black and white and colour sensitometry and various types of colour film will be described. Colour sensitometers and densitometers will be reviewed and colour pro-

cessing control sensitometry will be described. The fifth lecture will concentrate on control by chemical analysis and, to conclude, colour printing and methods of colour adjustment will be described.

The syllabus and enrolment forms will be inserted in the December issue of the JOURNAL and you are advised to make application early.



## BOOK REVIEWS

*Books reviewed may be seen in the Society's Library*

**FLUORESCENT LIGHTING.** Edited by Prof. Dr. C. Zwikker, *Philips Technical Library*, Cleaver Hume Press, Ltd., pp. 260.

This is another book in the series "Light and Lighting" published by the Philips Technical Library and like all the books in that series shows a high general standard of production. The type and photographs are clear and are well produced and the diagrams in particular are very good.

This book differs from the other books in the series which were mainly by one author each, in being written by a group of nine authors, each an expert, under the general editorship of Dr. Zwikker. There have been a number of surveys of fluorescent lighting published during the past few years, but with such a rapidly developing section of the lighting industry each fresh survey has an opportunity of dealing more completely with recent developments. The present book can be criticised only on one main issue. It does not use to the full this opportunity of surveying the whole field of lighting irrespective of where the developments originate. It is a Philips production and it is perhaps natural to concentrate on the typical lamps and gear used in Holland with some reference to English and American types. It tends to ignore developments in other countries and certain omissions occur which rather spoil it as a full survey.

One such omission is in the chapter on applications dealing with cinemas and theatres. It is stated that "lighting systems using fluorescent lamps can be dimmed only by means of costly electrical equipment including thyatron valves." Examination of English lighting journals during the last two years will show that this is only one method and other simpler methods have been described which are sufficiently inexpensive to compete with the normal incandescent installations. That is, however, the only major criticism.

An excellent feature of the book is a number of sections which deal very fully with their subjects. One such section is Chapter 3 on "Colour of the Light Emitted by Tubular Fluorescent Lamps; Colour Rendering." This does more than the title indicates and gives a very clear description of colour measurement problems including the computation of colour points and then goes on to deal with the very difficult question of specifying the colour rendering properties of a given lamp. The general description of the various processes is well done and it only becomes indefinite when the decision has to be made as to the difference in "steps" on the chromaticity diagram which is permissible. No clear reason is given for assuming that the three

steps difference of the "Daylight" fluorescent lamps is satisfactory.

The chapter on "Lamp Types" is too brief to give a full survey and it compares unfavourably with the much older survey made by Amick. It is also inaccurate in its description of the very interesting problems arising from the use of krypton as a fill gas. The statement is made that owing to the low arc voltage the lamp is not suitable for use on 220v. mains. This is surely a misunderstanding. Any difficulty that there is arises from the differing ionization levels in argon and krypton which affects the striking voltage of the lamps.

One other chapter deserves special mention. Ballasts have been dealt with very clearly by Hehenkamp with sufficient, but not too much, mathematics for the ordinary reader. The problems set the ballast engineer by the fittings designer with his continual demand for slimmer and more elongated forms are considered. The final solution of such problems is necessarily a matter of compromise and to quote the book "each instance must be reviewed on its own merits." Any compromise solution of this sort is difficult to explain concisely to the reader unfamiliar with the field and it is useful to get reprinted in this book some of the interesting article on "Minimum Cost Transformers and Chokes" by Hehenkamp and Hamaker (Philips Research Reports, 5, 357-394, October 1950), in which the balance between design and cost factors is considered.

J. W. STRANGE.

**AMPLIFIERS.** G. A. Briggs & H. H. Garner, *Wharfedale Wireless Works*, pp. 215, 15s. 6d.

Mr. Briggs is the author of two successful books on loudspeakers and sound reproduction. This work completes the trio. The book is lucid and concise and the authors are to be congratulated on their choice of illustrations, particularly the use of oscilloscope recordings.

Commencing with an analysis and discussion of the basic requirements of good quality reproduction, the authors proceed to deal in turn with decoupling, instability, negative feed back, phase splitters, filters, tone compensation, and finally lead up to a description and test of the Garner amplifier, including its ancillary units, a pre-amplifier and T.R.F. feeder. The book can be recommended to those seeking a good groundwork in amplifier design without encumbering themselves with involved and highly technical electro-acoustic problems or with mathematical formulae.

L. KNOPP.

### I. D. WRATTEN, Hon. F.B.K.S., F.R.P.S.

All the members of the Society will be pleased to learn that Mr. I. D. Wratten, Hon. F.B.K.S., F.R.P.S., has been appointed a Director of Messrs. Kodak, Ltd.

The British Kinematograph Society has special reasons for congratulating Denis Wratten on his appointment, remembering with gratitude the great service he gave the Society when, as its President from 1946 to 1948, his high qualities of leadership, his vast fund of technical knowledge and urbane personality enhanced the prestige of the Society immeasurably.

In making this appointment Messrs. Kodak has honoured one of the most famous names in photography, for Denis Wratten's grandfather founded the firm of Wratten & Wainwright in 1877.

Educated in this country, Denis Wratten went to Rochester, New York, at an early age and worked in the laboratories of the Eastman Kodak Company on what was then the new 16 mm. "Cine-Kodak" reversal process. From there he joined the Eastman Kodak Motion Picture Film Division in Hollywood, and in 1934 he came to Kodak Ltd., in London.

On behalf of all the Society's members good wishes for his success is extended to Denis Wratten.

A.W.W.



### LIBRARY NOTES

There are few to-day who question the impact of television on the motion picture industry. The force of this still-new scientific development has been strongly felt, and it may be expected that the technical resources of these two entertainment media will integrate more and more closely as time goes on. The present accelerating swing to the all-colour film entertainment programme follows directly from the American television industry's post-war rapid progress towards a practical and economic colour television broadcasting-receiving system. Motion picture production units making a product specifically intended for television programmes are appearing in this country and we even have the intriguing spectacle of a unit making motion pictures by television for television. It looks like the beginnings of a technical revolution in the motion picture world.

Many members of the Society foresee the close relationship which must eventually form between the motion picture and television industries and hence the widespread interest in the course of study on Television in the Kinema and the institution of a Television Division within the Society. The strong leavening of television subjects in the current programme of papers is another sign of this awareness.

The library is here to assist members wanting to know more of television in its varied aspects. With an infant industry developing at great speed it is inevitable that technical books become slightly out of date almost before they are published, and so periodicals must be relied on more than usual for the latest information. Nevertheless, the following books available from the library are recommended for those wishing to know something of television techniques:

Television Principles and Practice. *F. J. Camm.*  
 The Art of Television. *Jan Bussell.*  
 Newnes Television Manual.  
 Newnes Television To-day.  
 Television Receiving Equipment. *W. T. Cocking.*  
 RCA Theatre Television.

The following periodicals, mostly available on loan from the library, often contain valuable information on the subject of television.

Journal of the Television Society.  
 Journal of the S.M.P. & T.E.  
 Journal of the Brit. I.R.E.  
 Philips Technical Review.  
 RCA Review.



## THE COUNCIL

*Summary of the meeting held on Wednesday, October 1, 1952, at 164 Shaftesbury Avenue, London, W.C.2.*

**Present :** Mr. L. Knopp (*President*) in the Chair, and Messrs. B. Honri (*Vice-President*), R. E. Pulman (*Hon. Treasurer*), H. S. Hind (*Deputy Vice-President*), F. S. Hawkins and N. Leevvers.

**In Attendance :** Miss J. Poynton (*Secretary*).

**Apologies for Absence :** Apologies for absence were received from the Hon. Secretary, and from Messrs. G. J. Craig, T. W. Howard, T. M. C. Lance, S. A. Stevens and D. Ward.

## COMMITTEE REPORTS

**Membership Committee.**—The following is elected:

Frank Philip Gloyns (Member), Denham Laboratories Ltd., Denham, Bucks.

The following is transferred from Associateship to Corporate Membership :

Alan Arthur Richardson, The British Broadcasting Corporation, Lime Grove Studios, Shepherd's Bush, London, W.12.

The resignations of two members were noted with regret.

*Report received and adopted.*

**Education Committee.**—A Course on Television in the Kinema will commence on November 18, 1952, at the Birmingham and Midland Institute, Paradise Street, Birmingham. The same course will commence in Leeds on January 13, 1953, at The Lecture Hall, City Museum, Leeds 1. A Course on Colour Film Processing and Colour Sensitometry will commence at the Colonial Film Unit Theatre, 21 Soho Square, W.1, on January 19, 1953.

*Report received and adopted.*

**Film Production Division.**—Mr. W. S. Bland has been appointed the Divisional Hon. Secretary in the place of Mr. J. P. H. Walton who has now left the industry.

*Report received and adopted.*

**Theatre Division.**—Consideration is being given to the desirability of (a) arranging a specialised course of instruction for the provinces on the subjects of presentation, the care and maintenance of projection equipment, optics and carbons, etc., and (b) publishing a recommended Code of Practice for distribution after the lectures have taken place.

*Report received and adopted.*

The proceedings then terminated.

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*Illustrated:*

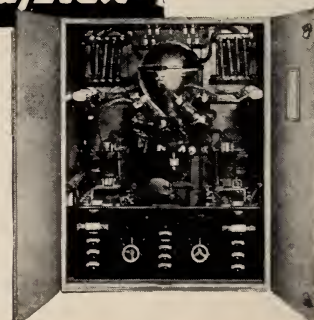
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# BRITISH KINEMATOGRAPHY

VOLUME 21 No. 6

HON. TECHNICAL EDITOR :  
R. J. T. BROWN, D.S.C., B.Sc. (Fellow)

DECEMBER, 1952

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## CHRISTMAS MESSAGE

TO all members of the British Kinematograph Society, whether they be in the United Kingdom, the Commonwealth or in a foreign land, and whether they be in film studios, on location, or in cinemas, laboratories or factories, I send a Christmas greeting and warm wishes for your future happiness and prosperity.

At this time we must not forget those who have suffered hardship because of the difficulties which beset the industry, and to them I send a special greeting, and a wish that the New Year, Coronation Year, will witness a fresh and successful impetus in our industry.

The main theme of the Society's work is, through its various channels, to introduce new developments and new processes that will ultimately benefit the industry and, in so far as lies within its power, to provide opportunity for the technician and the engineer to perfect and broaden the scope of his activity.

During the year just closing we have not been static; some important developments have been made in 1952: an electronic camera has emerged which, it is claimed, will greatly reduce costs and

improve filming technique; there is a striped film equipment which will facilitate the recording and reproduction of sound by means of magnetically coated film; we have seen advances in colour processes which portend further increase in colour film production. In the television field there has been a widening of the political outlook, and sponsored television and large screen reproduction have approached a greater certainty in a comparatively short space of time.

Much will depend upon the future. I am conscious of the responsibility which rests with this young Society. In an ever increasing measure it must lead the way in technical advances. The Society's competence will be a yardstick for the demands made upon it. In sending this greeting therefore, not only do I thank you for your support in the past but voice the hope that on the eve of an historical year we may look forward confidently, and by our sustained effort, provide a technical Society for the British Film Industry which will be capable of meeting the contingencies of the year.

LESLIE KNOPP,  
President.

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## SEPARATION NEGATIVES AND POSITIVES FOR COLOUR FILMS

G. W. Ashton, A.R.P.S. (Member)\* and P. Jenkins, A.R.P.S. (Member)\*

*Read to a Meeting of the Film Production Division on October 15, 1952*

**T**HIS paper does not set out to be a survey of all the possible methods of making colour separation negatives and positives but is simply a brief record of some of those methods and their basic controls which were used with the British Tricolour Process, and which we feel may be of value to other workers who are, perhaps, just entering the field of colour cinematography.

To the newcomer it might seem that with the increasing number of integral tripack colour processes available to-day there is no need for separation negatives. On the face of the evidence it would appear that the primary advantage of integral tripacks is that they can be used almost as simply as black and white, release prints being made direct from the camera original. But whilst it is true that colour prints can be made in this way, there is, and will be in the foreseeable future in our opinion, always a place for separation negatives, and along with separation positives they are of great importance even when a monopack process is used.

Before proceeding further it would be as well to discuss exactly what separations are, and what the requirements are if they are to be satisfactory.

Separations are an analysis, recorded in black and white, either positive or negative, of the colours and tones of the original subject. It is generally agreed to-day that three such records are needed for adequate colour reproduction, a blue, a red and a green. However, for many years films have been made using only two records and it must be agreed that the results obtained dividing the spectrum into two bands rather than three have provided the industry with simpler, cheaper colour than would have been possible in the meantime. However, we do not

propose to discuss two-colour systems, simply because they are now virtually obsolete.

### Methods of making Separations

The three colour records can be obtained in three ways in practice :

- (1) By photographing the original subject on panchromatic stock through blue, red and green filters.
- (2) By the use of three special film stocks which each record only one of the three spectral bands.
- (3) By using an integral tripack material in which three superimposed emulsion layers record the three spectral bands and generate complementary coloured dyestuffs. Separations can then be made from this film in the laboratory.

The first two of these methods we can conveniently call direct separation and the last indirect separation. The choice of direct or indirect methods of producing separations depends on a number of considerations ; as a generalisation direct separations produce superior quality results at the cost of needing special camera equipment for live action at least, which is cumbersome and in some cases not always available. Indirect separations from monopack have the great advantage that normal black and white cameras can be used, but they need more light and are considerably more complex from the point of view of laboratory work than direct separations.

### General Requirements

There are three fundamental requirements for separations which apply to all types and these must be met irrespective of how or when the negatives or positives are made. These are :

\* Formerly British Tricolour Processes Ltd., London.

- (1) The three images on the film or films must be of the same size ;
- (2) they must be placed in exactly the same position on the film or films, that is they must be in register, and
- (3) they should, for all print processes, have substantially equal contrast.

There is not generally, with one exception, any difficulty in fulfilling the first requirement, that of size, since the lenses in common use to-day are all corrected for chromatic aberration. The exception is, of course, the three-strip camera which will be discussed more fully later.

The second requirement, registration, is in some degree automatic since it is managed by holding the print material and the negatives in fixed position by means of the perforations,

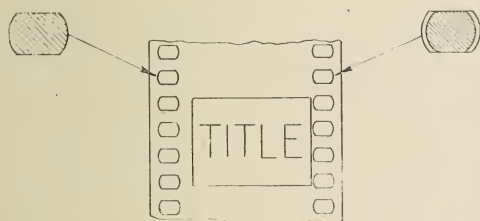


Fig. 1.

*Positions of large and small register pins in relation to image and track.*

the same perforations having been used in the camera for this purpose. It is common practice to use film stock with Bell-Howell perforations, or one of the two modifications of Bell-Howell perforation, Dubray-Howell<sup>1</sup> or Ansco Modified Negatives<sup>2</sup>, for colour work. The perforation which is at the top of the picture on the track side is engaged with a register pin which is fully fitting and the corresponding perforation on the non-track side is engaged with a register pin which fits vertically only, to prevent skewing of the film, whilst at the same time allowing for shrinkage across the film width. These relative positions of the big and the small pin in all camera and printing equipment could well be adopted as a universal standard<sup>3</sup>. (Fig. 1).

The last requirement, that of equal contrast, does depend on the release print process

which is to be used, but we consider that it is highly desirable, for all direct separation negatives at least, to have equal gammas and in addition to process to gammas within the normal range of 0.65 to 0.70.

The simplest forms of direct separation negatives are successive strip and successive frame separation negatives and these are dealt with first.

## DIRECT SEPARATIONS

### Successive Strip and Frame Negatives— Photography

These methods are widely known and used since they need the minimum of special equipment ; they are used for the production of cartoon and puppet films in colour.

In successive strip and frame photography the subject is photographed with a normal black and white camera which must be firmly fixed in position with reference to the subject, for example on a cartoon bench<sup>4</sup>. In the successive strip method the work is shot three times, each time to full screen footage, once through a blue filter, once through a red filter and finally through a green filter. This method can only be used where the subject is completely static and can be held in a fixed position for considerable periods. Such work as simple title cards or drawings without animation for slide-on-film can be handled in this way. The general conditions for successive strip photography are exactly the same as for successive frame and so can be better discussed under that heading.

Successive frame work consists of photographing three frames in the camera, one each through the blue, red and green filters, for every screen frame. This method thus produces a single strip of film three times the length of the final screen footage. There must be absolutely no subject movement between the exposure of the blue, red and green frames.

A medium speed panchromatic stock is generally used, Plus X more often than not, and the frames should be photographed with the filter order which has become almost



standard, blue, red, green. The camera must have register pins fitting in the perforations which have been already described and suitable cameras are the Bell-Howell with a Unit I movement or a Mitchell. For good register the pins should be of the correct dimensions and show no wear.

The filters are usually mounted in a disc which rotates in front of the camera lens either continuously or in steps in synchronism with the film pull-down. Of the two the latter method is to be preferred and a very neat filter disc and Maltese cross motion which achieves this action is made by Ernest F. Moy Ltd. The filters should be gelatine rather than glass. Glass filters are not satisfactory since if one or another is mounted at a slight angle to its fellows the frames will not register due to varying amounts of refrac-

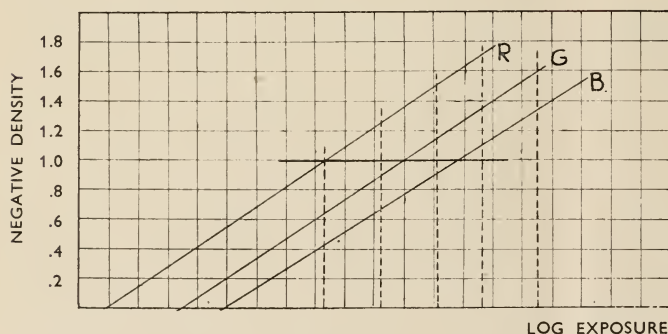


Fig. 2.

*Red and green record characteristics plotted from log. E values derived from the blue record negative. For this hypothetical filter set neutral densities of 0.35 and 0.90 would be required to balance green and red filter transmissions to the blue.*

tion; gelatine filters avoid this difficulty since their thickness is negligible. The Wratten Tricolour Set are the filters most usually used, and since in tungsten lighting these filters do not give equally exposed negatives at the same stop, neutral density must be added to them to equalise their transmission. It is possible to do this by adding separate neutrals to the red and green filters but it is far better practice to order the tricolour set with the neutral densities combined from the manufacturers, specifying the lighting and the film stock with which they are to be used.

If it is necessary for some reason to add the

neutral density as separate filters the amount which is required can very simply be calculated by photographing a card grey scale comprising five or six steps of progressively darker tones from a white to a black, placed on the bench, through each of the plain tricolour filters and developing the negatives to a known IIB gamma (Fig. 2). A line at that gamma should then be plotted on a sheet of graph paper and the densities of the steps in the grey scale on the blue filter negative plotted along this line. Perpendiculars can then be dropped from these points on the line to the log. E axis and the grey scale densities for the other two negatives plotted against these log. E values. This is, of course, only an approximate method of finding the brightness of the grey scale steps as photographed but is sufficiently accurate for practical purposes.

This will give two other curves displaced to the left of the blue curve, probably with slightly higher contrast. The log. E shift of these two curves at a mid-density level, say 1.0, should then be measured, and these figures, actually the log. exposure change caused by the filters, are the values of neutral density required for the red and green filters under these lighting conditions.

In photographing successive strip and successive frame work a card grey scale of some five or six steps, preferably with a black step made of flock paper, should be photographed at the head end of every

scene as an exposure check and for grading. The steps of the scale can be made by fogging bromide paper and a suitable size for each step is  $1\frac{1}{2}$  ins. by 2 ins. If the scenes are photographed in the order in which they will appear in the final print and on one batch of raw stock one length, of say three feet for successive frame, for each magazine loading will be enough.

### Laboratory Processing and Control

Successive frame negatives are generally processed to a normal IIB gamma for the

negative stock they are photographed on, say within the range 0.65 to 0.70. Since successive strip negatives *are* in separate strips, however, a slight variation in the white light gamma can be made for the blue record. Due to the well-known wavelength-gamma effect panchromatic stock usually gives a lower contrast when exposed to blue light<sup>5</sup> so the blue record will be flatter than the other two. In successive frame there is nothing that can be done about this, but with successive strip the blue record can be given a slightly longer development time to equalise the contrasts. If the red and green records are developed to a white light gamma of 0.68 the blue will usually be about right if developed to 0.71 or 0.72.

After processing, the procedure adopted with successive frame negatives will depend on the print process used ; if optical printing of the releases is practicable the negatives may be printed on an optical printer set up to skip two frames in three. The blue record is then printed on one run, the red on a second and the green on a third. If such a procedure is not possible a master positive must be made on a suitable stock such as Eastman 5365 and three duplicate negatives made on an optical printer, skipping out the three records on to a duplicating negative material such as Eastman 5203. This method of working has the advantage that it also offers an opportunity to equalise the contrasts of the three records if this is necessary, since the gamma of any of the records can be varied by varying the processing time at the duplicate negative stage. In addition any optical effects desired may be incorporated at the same time. The optical printer need only be of fairly simple construction since basically only a 1 to 1 enlargement ratio is required. However all the printer movements must have register pins in the correct positions, that is the same positions relative to the frame as were used in the original camera. The contract printer used to make the master positive should preferably have slightly larger than silent dimension aperture since this will give black frame lines on the master. If the frame lines on the master are clear and

a silent gate is used on the optical printer there will be a considerable amount of light passed which will flare in the lens and degrade the negative quite seriously. The master positive and duplicate negative gammas should be normal unless the release process demands an abnormal contrast in which case the dupe gamma may be altered as necessary. Compensation must of course be made for the increase in contrast which optical printing will give.

### Grading of Separations

The grading method which we have found satisfactory for all separations depends on the fact that if a single silver negative is printed three times in the three printing colours at the same printer light for each it should give a neutral grey print<sup>6</sup>. Similarly, three exactly equally exposed separation negatives printed under the same conditions would give a correctly colour balanced print with any neutral grey included being reproduced as a neutral grey. If this is so (and it should be so for a correctly running print process) and the printers are correctly calibrated in known increments of log. E, that is, known increments of negative density, for each light, the relative printer light settings for three separation negatives can be simply found from grey scale density readings.

An example will perhaps make this clearer. Assuming that the printer light change is calibrated from 1 to 22 with each point being set at 0.05 log. E, one of the negative frames is chosen as standard, say the green record since this looks most like an ordinary panchromatic negative and so is easy to grade visually. The white step of the grey scale (the darkest on the negatives) has, say, on the green record, a density of 1.35, the blue 1.25 and the red 1.40. By trial and error the white step density which gives a normal overall print density will be known and fixed as a standard for the process, say 1.40 is light 12 ; then the green record will need light 11, the blue, light 9 and the red 12. These densities, ratios and gradings should be tabulated as in Table for each scene.

Table 1

Blue	Red	Green
1.25	1.40	1.35
-2	+1	Lt. 11
9	12	11

With minor modifications this system can be applied to any type of separation. But not all negative can be graded for overall density by the simple use of a green record maximum density reading as we have just described, it is satisfactory for cartoon work, but for live action or puppet should be modified either by experienced examination of the negative—sight grading—or any other commonly used grading method such as spot density reading or Cinex strips.

In the case of successive frame negative which has to be skipped out on a duplicate negative before release printing, the individual records can be graded before the master positive is made and an average grading for the three records assigned. The duplicate negatives, which will be printed under standard

conditions, can then be given individual gradings for release printing in exactly the same way as original negative.

### Separation Negatives from Beam-Splitter Cameras—Photography

Beam splitter cameras use three special Eastman raw stocks which each record only one-third of the spectrum. These three films are designed to be used in a camera layout which has become the only successful one of the many possible film arrangements in a beam-splitting colour camera. Two practical examples of cameras of this type are the British Tricolour<sup>7</sup> (Fig. 3) and the Technicolor. This arrangement is generally known as bi-pack and one—a semi-reflecting prism is

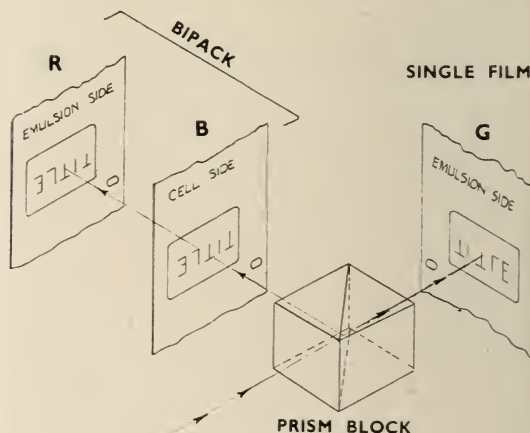


Fig. 4.

Prism, gate and film layout used in the three-strip colour camera.

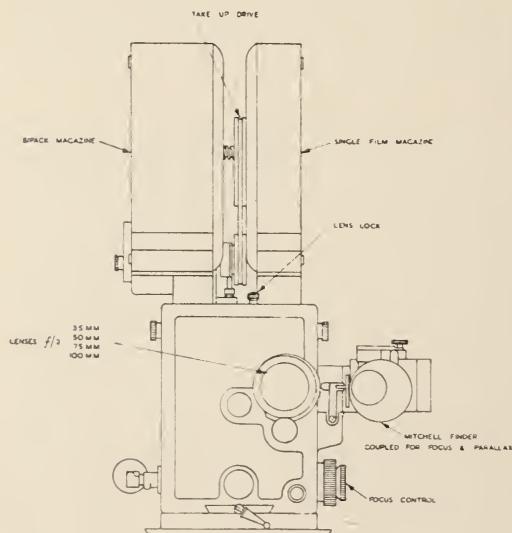


Fig. 3.

Front elevation of the British Tricolour camera showing separate magazines for the green record single film and the blue and red record bipack.

placed behind the lens and a single, green recording film is placed in the direct beam from the camera lens and a blue and red recording bipack in the reflected beam. (Fig. 4). The front film of the bipack is blue recording and is exposed through the base; the emulsion of this film carries on its upper surface a thin layer of red dye which effectively restricts the rear film to recording the red in spite of its additional blue sensitivity. The single film is in fact equally sensitive to blue as it is to green but is exposed through a light yellow filter, an Aero 2, which cuts off at about 460-470 mμ.

There are two types of this three strip stock being made by Eastman at the present



moment. The older type, gives more or less equally exposed records in light of daylight quality, about 6,500 K. For high intensity arcs a Y-1 filter gives correct balance whilst a Duarc is satisfactory without a filter. A key light level of 450 foot candles is needed for this film at  $f/2$  and a gold semi-reflector in the camera prism gives the most efficient transmittance-reflectance ratio by virtue of its slightly dichroic effect, that is by transmitted

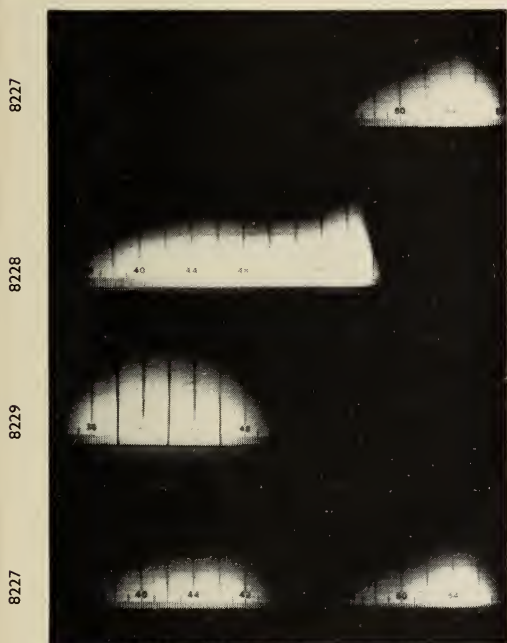


Fig. 5.

Wedge spectrograms of the three film stocks used in the three-strip colour camera. The basic sensitivity of the red record film (8227) is shown at the bottom and after filtering through the red dye layer on the surface of the blue record emulsion (8229) at the top of the figure. The green record (8228) is exposed through a yellow filter.

light it looks greenish, by reflected light reddish-yellow.

The latest type of three strip stock, for which the spectral sensitivity curves are shown in Fig. 5, is somewhat faster than the older type and will give similar results under the same conditions as the older films but at 300 foot candles and  $f/2$ . If a silver semi-reflector is used in the prism a higher blue reflectance can be obtained (the gold gives a rather poor blue reflectance) and the new

emulsions can be exposed in tungsten lighting of about 3,350 K and at key light levels of the order of 150 foot candles<sup>8</sup>.

The registration of the negatives obtained in a three-strip camera is primarily a matter of engineering. It involves the precise fitting of the lenses, the prism and the two gates so that the three images are of exactly the same size and will be in register if printed on suitable gates with a fully fitting pin in the correct position. Good register in a colour camera also demands engineering to exceedingly fine limits. A difference of image placing of  $2/10$  of  $1/1,000$ in. is visible as a colour fringe,  $1/10$  of  $1/1,000$ in. as a lack of critical definition. Even with the most careful maintenance such accuracy is difficult to hold under normal studio and location conditions and so there is always a possibility that negatives made in a colour camera may be out of register.

Register may vary in one or more of three ways—horizontally, vertically or skew. The first two can be fairly simply corrected by optical printing but skew register is very difficult to correct. We feel that it is probable that an optical printer is, on occasion, an essential adjunct to a colour camera. The most scrupulous camera maintenance is also needed to ensure the best possible bipack contact at the moment of exposure. Consistent with good rear element definition, the pressure on the bipack should be small enough to ensure that scratches are avoided. An average of 25 to 28 lines per millimetre resolution on the rear film of the bipack should be aimed at, and under good conditions 30 to 33 lines per millimetre should be possible.

When photographing with a three-strip camera, there are two types of chart which must be shot from time to time if adequate control is to be maintained by the laboratory. It may well be felt by cameramen that these gadgets are simply a means of increasing the footage shot for the laboratory and a routine which consumes valuable time on the floor, but both of them are essential to the laboratory and can save a good deal of print footage in the long run. The charts required are a

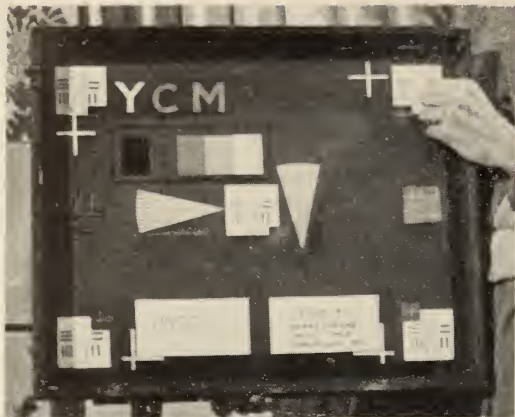


Fig. 6.

*The register and resolution chart, which is normally photographed to fill the frame, i.e., at a standard distance with a standard (50mm.) lens.*

register and resolution chart and grey scale combined, and a device which has come to be called a lily. The register chart should be shot at the start of each day's work and once for each fresh magazine. The lily must be photographed at the end of every scene.

The register chart with its clearly marked indices at fixed distances makes the measurement of any lack of register between the three negatives quick and easy to perform. (Fig. 6). The resolution chart makes it easy to check the bipack contact; the grey scale provides a rough test of the relative contrast of the three negatives. The lily (Fig. 7) provides the standard white area mentioned earlier, which is used in grading.

The lily must, of course, be photographed under lighting conditions which are typical for the scene it represents and not in shadow. It must be close enough to the camera to give an area on the negative large enough to enable density measurements to be made without difficulty and if any effects filters are being used over the lamps or the lens the lily must be shot with the filters off. The short length of film which includes the lily, say 10 to 20 feet, should consist of half with the lily in frame and half a straightforward shot of the scene to which it refers, with the actors, if any, in an average grouping. After development of the negative all these reference scenes are cut

from the roll and joined up into a separate roll of their own for grading and printing. In this way an idea of the general balance of the scenes can be obtained and the actual negative can be canned up when the reference scenes have been cut out and not again handled until final cutting of the picture. When this stage is reached the final gradings are transferred from the pilot roll to the cut negative roll. In addition this procedure enables the grading, lighting and register of the scenes to be checked with the minimum expenditure of print footage, and as soon as possible the pilot negative rolls can be printed and generally used for test purposes as desired in the laboratory.

### Laboratory Processing and Control

Three strip materials can be processed in just the same way as normal black and white negative materials with only one or two minor reservations. First their contrast must be fixed by the print process being used, but unless an unusual release material such as Dupont 275 is being used, an effort should be made to develop them to the gammas they were designed for, that is in the range 0.65 to 0.70.

In exposing the IIB sensitometer strips the green record can be exposed to light, filtered yellow with the Aero 2, emulsion down in the usual way. The bipack is exposed to white light but as a bipack, that is with the base

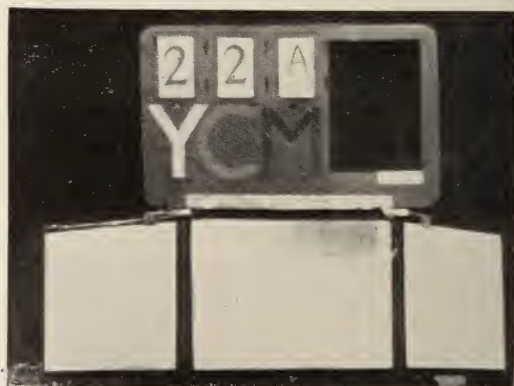


Fig. 7.

*The lily, which provides a standard white reference object for grading.*



side of the front film to the light source and with the rear film emulsion down on top of it. If a visual densitometer is used to plot the strips the red dye of the front film must be cleared first, but with a photo-electric densitometer such as the Western Electric RA-1100B there is no need to do this.

In cases where exposure is necessarily on the low side the record which will show the under-exposure worst is the blue. This is especially the case when incandescent lighting is used since even with the fastest blue sensitive emulsion the lack of blue in tungsten lighting makes it difficult to achieve a blue record which is as well exposed as the other two. For processing the blue record only a special developer which gave a useful increase in effective emulsion speed was worked out by Keith M. Hornsby ; it has the following formula :—

Metol	200 gm.
Hydroquinone	500 gm.
Sodium Sulphite (Anhyd)	100 kgm.
Sodium Carbonate (Anhyd)	10 kgm.
Water to	1,000 litres.

The principal difficulty with developers of this type is that they are rather wasteful of chemicals since they need to be boosted quite heavily (with the same formula as a replenisher) in order to keep the bromide concentration low and the emulsion speed high. The high alkali concentration gives the maximum speed in the lower negative densities, while the low concentration of developing agents keeps down the densities produced at the higher exposure levels.

An alternative approach to this problem of the poor exposure of the blue record is to use latensification, a procedure which is receiving a good deal of attention nowadays in black and white work and has also been used on bipack by Cinecolor. Some very useful research on methods of latensification was done over ten years ago by G. S. Moore, of Ilford Ltd., and all the practical details needed for this process are given in the literature<sup>9-11</sup>. This method of increasing the speed of motion picture film is a very useful one since it is not too difficult to

carry out, is fairly easily controllable, and gives roughly double the effective emulsion speed.

The red dye which is incorporated into the emulsion on the blue record is a serious nuisance to the laboratory since its removal is not easy and is a decidedly smelly operation with some risk of emulsion damage due to softening and extra handling. A saturated solution of sodium hydrosulphite is usually used for this dye removal and this can be incorporated as an extra tank on the processing machine or as a separate smaller processing machine. We prefer the latter method since the dye is sometime obstinate and needs a second treatment. This makes life intolerably complicated if a second run is needed on the regular negative processing machine.

### Printing of Negative

The printing of the separation negative made in a three strip camera must, of course, be done on a register pin printer ; but the situation is complicated by the fact that the red record (cyan printer) is laterally inverted since it is photographed with the normal emulsion position but after reflection by the beam splitter. To maintain the correct image orientation and correct register pin position the red record negative has to be printed through its base, that is with the celluloid side to the emulsion of the raw stock. This naturally tends to make a print from this negative less sharp than the other two, and since the red record is already less sharp than the other two by virtue of the fact that it is the rear element of the bipack, this is quite a serious matter. This problem was however satisfactorily solved by the use of printers with a specially designed optical system which gave substantially parallel light.

The alternative to a parallel light printer is optical printing. Three master positives must be made from the three negatives on a contact printer with all three negatives emulsion to emulsion with the raw stock. This means that two gates will be needed, with the large register pin on opposite sides and with silent aperture. From these master



positives, duplicate negatives can be made in the optical printer with the cyan master printed through the base. This gives three right-way-round duplicate negatives.

Making master positives and duplicate negatives from three-strip negatives corresponds sensitometrically to good black and white practice exactly. In addition care must be taken to maintain equality of contrast for all three records throughout the process, and it is good technique, just as it is in black and white to splice in a short length of a transparency grey scale to the tail of all rolls which are to be duplicated<sup>12</sup>. For three-colour the scale should consist of about twelve steps and should be photographed on three strip negative materials so that they will have the same base characteristics as the negative they are spliced up with. From these grey scales the print-through gammas can be plotted for all stages of the process and each step thus checked for deviation from the normal.

The effects of unequal contrast in colour photography are not perhaps as fully recognised as they ought to be, although they are responsible for many of the out of balance effects which are commonly seen in processes which use monopack throughout. They are particularly troublesome here because it is generally not possible with monopack to do anything to correct such unequal contrasts. However we shall have more to say on this subject later.

If, for example, the blue record negative is flatter than the other two and the exposure used in printing this negative is correct for the middle of the tone scale then both the highlights and the shadows will show colour casts, but in opposite directions—the highlights will be yellow and the shadows blue. That is the situation assuming that both the heavy densities and the light densities in the print at these points should be neutral; if they form part of any coloured areas they will affect this colour rendering in a similar way, the areas which should have a small proportion of yellow will have too much and those areas which should carry a heavy weight of yellow will not have enough. As can be

imagined this would have quite a serious effect on the colour rendition. Table II shows the effects in the final print if one record is of lower contrast than the other two.

**Table II**

Colour Record	Appearance of		
	Highlights	Mid-Tones	Shadows
Flat blue neg.	Yellow	Correct	Blue
Flat red. neg.	Cyan	Correct	Red
Flat green neg.	Magenta	Correct	Green

The same reasoning can be followed through for unequal contrast of any of the other records, and if all three have different contrast then the results can be quite disastrous. At IIB control gammas about 0.70 a variation in gamma of 0.05 between records is clearly visible and errors of 0.03 are noticeable.

### Grading

The grading of three strip negatives may be carried out working on the same basic assumptions as the grading of successive frame negatives. The basic grading for the green record negative can be arrived at by any of the methods in common use in black and white laboratory practice—Cinex strips, visually by experienced operators, or by a combination of visual and spot density measurements. We believe that the last two methods are more satisfactory in practice since the making of Cinex strips usually holds up the flow of work considerably.

As soon as each scene has been given a green record grading, the density of a certain point on the lily, using the same frame and the same point for each record, is read and noted. The other two records are then graded directly from these density readings.

Assuming that printer points of 0.05 log. E are used and lily readings of 1.20, 1.25 and 1.15 are obtained for the blue, red and green negatives of a certain scene, then the gradings would be +1 and +2 points relative to the

green, whatever it was. This method of grading does, of course, pre-suppose that all negatives have equal contrast and it equalises the highlights for balance. If it were used with a release print material which needed negatives of unequal contrast it would no longer hold good. The densities, ratios and gradings should be tabulated for each scene as in Table III.

Table III

	Blue	Red	Green
Lily density	1.20	1.25	1.15
	+ 1	+ 2	7
Lights ...	8	9	7

This grading method when used for three strip negatives has the disadvantage that if the negatives are fairly heavily exposed there is a risk that the lily will have densities which are over the shoulder of the blue record. The blue record gives a low maximum density because it is thinly coated, and a thin emulsion is essential if anything like good red record definition is to be obtained.

So for lily densities on the green record greater than about 1.45 there is a likelihood that the balance given by the three density readings will not be the best balance for the majority of the tone scale in the scene. Of course, this overexposure of the lily can be avoided by care on the part of the camera crew, but there are bound to be times when the lily is more brightly lit than the laboratory technician would prefer. Sometimes the two side faces of the lily are a help since it is usual to find a rather lower lighting level on one side or the other, but with scenes shot out of doors care has to be taken since the side faces of the lily are probably lit with a high proportion of blue sky light. The best solution we found, was the use of a piece of a medium neutral grey card fixed to the lily.

There is to-day an increasing use of coloured effect lighting in motion picture work which can make life rather difficult for the grader. Even so in the normal way it is

perfectly possible, with experience, to grade all but a few unusual shots so that they are satisfactory on first printing. Of course, when finally the scenes are cut together, some re-grading will be needed to bring the scenes into line, but the more nearly the initial grading is correct, the smaller will be the errors to be corrected at the later stage and the fewer will be the attempts needed to obtain a first good print of the cut reels.

## INDIRECT SEPARATIONS

### Reversal and Negative Monopacks— Photography

The controls which are necessary in photography for the later separating of monopacks in the laboratory are identical for both reversal and negative films of this type. All the measures which should be standard for colour photography with a three-strip camera should be utilised when shooting monopack ; the register and resolution chart at the head of each magazine and at the start of each day's shooting and the lily and pilot scene at the end of each good take. With these aids the separation negatives which are made from monopack can be handled, after processing, in exactly the same way as direct separations made with a three-strip camera.

However, before this stage is reached the processing of the monopack and the processing of the separations made from it have to be controlled. For this vitally important part of the process some ten feet or so of grey scale photographed on each roll of monopack is the most satisfactory method. The grey scale should in this case be a transparency of, say, twelve steps, and it can be of such a size that it can be dropped into the matte box on the camera, so long as it is possible to focus on the scale placed this close.

There is, however, one serious difficulty in using a grey scale in this way. If the scale is made so that it fills the frame, the film in the gate will not see the densities of the scale in their true relationship, and since we would, using this system normally, use the actual scale densities, as measured on a densito-

meter, as base points on the log. E axis in later plotting of the three layer gammas of the monopack, we have to do something to correct this. The film does not see the densities in their correct relationship because of the inevitable uneven illumination of the camera lens, no matter how good a lens it is. This lack of illumination at the sides and corners of the frame arises from purely geometrical considerations (Lambert's Law) and in a lens of average focal length, 50 mm., the illumination at the edge of the frame will fall to about 40 per cent of that at the centre of the field and the readings on the film of the wedge step densities at these points will similarly be lower than they ought to be for

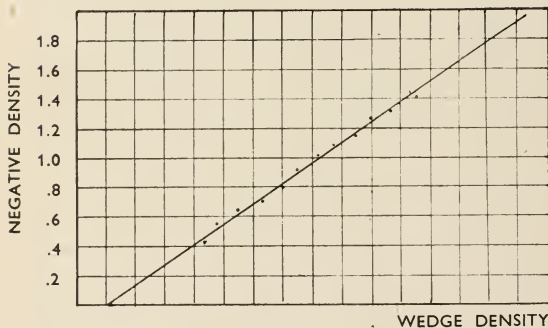


Fig. 8.

*Characteristic curve for one layer of a negative monopack. A twelve step wedge, four steps wide and three deep, photographed to fill the frame gives the first and fourth points of the three groups of four as lower densities than they ought to be, if no correction is made. Similarly the first and third groups will be too low in density generally.*

a correct plot of the gamma. In fact the densities obtained from all steps but those at the centre of the field will be off the true curve, and will make the drawing of the line connecting these points difficult if not impossible. (Fig. 8).

There are two possible ways of attacking this difficulty. The most obvious solution is to make the grey scale so small that it is not seriously influenced by this effect and to place it at the centre of the frame. The difficulty then is that the individual steps will be too small to read on the densitometer, especially as a photo-electric densitometer has to be used.

The second solution, and the one which we think is preferable, enables a full size scale to be used and consists of modifying the positions of the actual scale densities along the log. E axis when setting out the graphs so as to correct for this uneven lighting in the gate. If each camera has its own scale, as indeed it should, the log. E positions for that camera with that scale can be fixed once and for all by exposing a short length of Plus X in the camera with the scale in place, to the correct lighting level for this stock. This film is then developed to a known IIB gamma in the usual way. On a sheet of graph paper a line is drawn at this gamma and the densities of the steps of the scale on the film are read and plotted on this line. Perpendiculars can then be dropped from these points to the log. E axis. The points so obtained on the log. E axis are then the values to be used for that scale and that lens whenever the gammas are plotted. In fact they can be permanently marked on a strip of celluloid with an index mark and no actual log. E values need ever be used.

In use the grey scale is lit by directing the camera toward a standard white surface at a standard distance, uniformly illuminated to a specified level and at a stop which will give known correct exposure on the monopack stock in use.

After the film has been colour-developed (which we do not propose to discuss since it is outside the scope of this paper) the grey scale densities are read for each primary colour with a suitable photo-electric densitometer<sup>13-19</sup> and the three colour curves are plotted. The densitometer should have a sensitivity curve which corresponds fairly well with the curve of the panchromatic film which is to be used for the separation and the densities should be read through the same filters as will be used for making the separations. The density readings so obtained are plotted against the density values of the original transparency scale, modified as already described, and a gamma for each of the three layers of the monopack thus obtained. In theory, of course, the gamma for each of the layers should be exactly



the same, but in practice they are not, for a variety of reasons. Firstly, they may be deliberately unequal because the monopack in question is designed that way. Both the old Ansco Color Soft Gradation Camera Film Type 735 and the new Ansco Color Negative Film Type 843 give unequal layer contrasts by intent.

The variation in layer contrast may additionally be due to the difficulty of consistently processing monopack material. It is a well-known fact that quite small processing variations can produce disproportionately large colour balance changes, but what is not, we feel, quite so often realised is that colour contrast changes usually occur along with the balance change. This has been one of the most fruitful causes of poor screen quality with processes which use monopacks for camera and release prints. Although it is relatively simple to correct out-of-balance effects in the camera original, from scene to scene in release printing, with filter packs, it is clearly impossible to vary the layer gammas of the release positive from scene to scene to correct contrast variations in the original. In fact it is only when an integrated colour process is used, a process which supplements the monopacks with separations made at some stage, that full control of the process becomes possible. That is why separations are of vital importance in colour motion pictures no matter what methods of producing the results are used.

Having plotted the gammas obtained on each roll of monopack (the gammas should at least remain consistent throughout the roll) the gammas to which the separation negatives or positives are to be developed can be calculated, since the overall gammas should be fixed as standards. It is at this stage that any unequal contrasts in the individual layers of the monopack are corrected.

#### Laboratory Processing and Control— Reversal Monopack

The reversal monopack is possibly the simpler of the two types for the laboratory, since it gives separation *negatives* in one printing stage. The only film of this type to

achieve any widespread use, apart from the special Technicolor monopack, processing and control of which is reserved to that company, was Ansco 735<sup>20</sup>. Past tense is used since it has now been replaced by the negative film 843. We found that acceptable release print quality could be obtained with 735 if separation negatives were made from it directly without masking; this was due, no doubt, to its low contrast and the well separated absorption maxima of the dyes generated.

The most severe problem encountered separating from any monopack is the high light intensity needed in the printers, since the narrow cut filters used (especially the blue) absorb large quantities of light. However a contact printer optical system worked out by one of the authors gave a printing speed of 15 feet/min. on 5203 stock using a 300 w. lamp. If necessary an increase in speed could be obtained by the use of Background X as raw stock. A register pin printer must of course be used and a further complication ensues because a reversal positive has a negative image orientation and if nothing is done to correct this the final picture will be laterally inverted. This can be corrected by printing the release through the base of the separation negatives, or more satisfactorily by making the separations on the optical printer.

#### Grading of Separations

The grading of the monopack itself for separations is, in our experience, done best visually. In any case, with reversal monopack there should not be any great variation from normal overall density; if there is, off-normal scenes will probably give poor screen quality anyway. In addition to visual grading it is possible to calculate the printer lights needed for separating by comparing the positions of the three colour characteristic curves after plotting with the colour densitometer. The distance to the right or left along the log. E axis from a known standard position deciding the printer light up or down from a fixed centre-scale light.

The separation negatives when made will, of course, have all the control devices which were photographed incorporated in them; the register and resolution charts and the lilies for each scene. So these negatives can be graded in just the same way as direct separations. However if the separating procedure has been properly carried out, controlled indirect separations can be made which will always print on the same light and all three records will print together on that light.

### **Laboratory Processing and Control— Negative Monopack**

In order to obtain separation negatives from a negative monopack it is first necessary to make separation positives. The negatives can then be made from these in a perfectly straightforward fashion in the same way as a single black and white dupe is made from a master positive. A register pin printer with correct pin positions has naturally to be used.

Until Eastman began to manufacture Eastman Panchromatic Separation Film Type 5216<sup>21</sup> there was no really satisfactory film on which separation positives could be made. What is needed is a film with similar grain and contrast characteristics to 5365 (Fine Grain Master Positive) but with a panchromatic emulsion. And there was no such film which would give satisfactory results at gammas around 1.40 to 1.50. We did find, however, that 5203 (Fine Grain Duplicating Negative) in a suitably energetic developer could be developed to quite surprisingly high gammas, although somewhat at the expense of graininess and resolution. It seems probable in the light of recent experience that Ilford Pan F with negative perforations might well prove to be the ideal material. However Eastman Type 5216 is by far the most satisfactory film for the job since that is what it was designed for. In fact it is recommended by Ansco for making separations from their colour negative since they apparently make no special separation film themselves.

Eastman 5216 gives gammas of the order of 1.40 when exposed through any one of the three recommended narrow-band filters

and developed for 8 to 12 minutes in D-76 with 0.8 gm./litre of potassium bromide added.

The speed of this film is more difficult to specify, but Kodak state that using a 500 w. lamp and an efficient optical system, 10 to 15 feet/min. should be obtained with the recommended filters. However these factors will naturally vary from one laboratory to another and the only possible way to find out if you have enough light is to test the material in practice.

The filters which are used for separating both Eastman and Ansco negative are the Wratten 48A + 2B for the blue, Wratten 16 + 61 for the green and Wratten 70 for the red. This common filter set-up for the two films will be welcomed by laboratory workers in colour for the only common factor between colour materials at the moment seems to be that monopacks have three emulsion layers. For printing, register pin printers must again be used throughout and it is worth noting that an iris type light change is to be preferred to the resistance type because of the colour temperature change which the latter type gives.

The laboratory control of separations from monopack negative is handled in exactly the same way as reversal, the key to control being the transparency grey scale photographed on each roll. Each type of colour negative is designed to be developed to a different gamma so obviously the gammas to which the separations are developed will be different. Eastman Colour Negative<sup>22</sup>, for example, works to a normal sort of figure, about 0.70 to 0.75 for each of the layers. Ansco Color Negative works to about 1.00 for the red and green and 1.15 for the blue. So from the Eastman film normal type master positives will be obtained with a gamma of 1.25 to 1.35, whereas from the Ansco film a distinctly soft positive will be needed with a recommended gamma of 0.75. In all these cases a IIB, or better, an intensity scale gamma strip should be used for process control. These strips have to be read with a piece of fixed out film over the eyepiece if a visual densitometer is used since the residual



absorbing dye left in the emulsion after processing gives the film a greenish colour. The grading of the colour negative is difficult to do visually because of the rather unusual appearance of such film, and so the purely sensitometric method of calculating the printer lights from the positions of the three characteristic curves must be used.

One of the minor advantages of a negative monopack system is that for the rushes a black and white print can be made just as easily as it can from a black and white negative, colour pilots only being supplied each day. The separating of the monopack can then be done when the lengths and edge numbers of the required takes have been decided from the black and white print.

## Conclusion

There is one omission from this paper which may at first sight seem a serious one—that of masking. However, this technique is hardly needed for direct separations and in the case of the Eastman monopack negative, separate masks are unnecessary since integral masks are formed in the material. Ansco Color Negative has not any such integral masks, but the results we have seen from this film lead us to think that the film is none the worse, as a material from which separations can be made, for its lack of coloured couplers. Finally most of the practical methods of running separate mask films are well covered by patents.

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## THE PRESENTATION OF 16mm. FILMS

H. S. Hind, A.M.I.E.E., F.R.P.S. (Fellow)\*

*Read to a Meeting of the 16mm. Film Division on October 8, 1952*

**W**HEN films are used, whether it be for entertainment, instruction or propaganda, the work involved can be divided into definite stages. First, there is the preparation of the script, which is followed by the production or the recording of picture and sound on to the film. Next is the preparation of release prints from the original records, and finally the presentation of the release print in the form of light and sound.

One of these stages differs from all the others in a single but very important respect. There is no second chance in presenting a film as there is in producing a film, where the picture can be shot again if it is not satisfactory in the first place. Even if the audience can be persuaded to wait, or to return at a later date, the bad impression created by the first faulty presentation will remain.

The 16mm. Film Division of the Society has a number of Committees working on the problems associated with the production and presentation of 16mm. films. While I do not wish to anticipate the reports of these Committees, I do not think I can do better in introducing this subject to-night, than to quote the conclusion, which will probably form a part of the report on 16mm. Film Presentation.

"The value of the film, and indeed its power, lies in its ability to transport the audience to other surroundings or even to a land of fantasy. If this power is to be used to the full, the audience must not be brought "back to earth" and there must be nothing to disturb the atmosphere which has been created by the producer of the film. The presentation must be given in an atmosphere of unobtrusive service and competence; there must be no sudden changes in the surroundings such as would be caused by external noises or the entry of extraneous light. The audience must not become fatigued by uncomfortable seats, or by eye strain, which quickly results from a poorly illuminated or unsteady picture. Any other influence which might have a disturbing effect

upon the concentration of the audience and result in making them aware of their real surroundings, must be avoided.

If the audience remains aware of the auditorium in which it is seated and the personnel who are presenting the film, then the value of the film is largely lost. Only by careful planning, by maintaining the equipment in first-class condition and by competence on the part of the staff can full advantage be made of films."

First of all let us analyse what is required for good presentation, or in other words, what constitutes good showmanship. Quite simply, the object is to hold the audience by visual and sound effects. To do this complete control of the aural and visual senses of each member of the audience must be taken. This is not always easy and of course depends to an enormous extent upon the contents of the film. On the other hand, the best film can be ruined by faulty presentation. It is immediately obvious that the eyes and ears of the audience must not be strained in any way, otherwise the resulting fatigue will produce one of two things: the members of the audience will either become aware of their real surroundings and cease to be engrossed in the picture and sound, or they will be entirely unaware of their surroundings, in fact, fast asleep. Further it is an advantage if all the other senses are in a dormant condition and do not intrude.

### The Auditorium

Starting with the auditorium and remembering the essential requirements which have been discussed, it is clear that there must be a restful atmosphere, restful not only to the senses not required but also to those that are required so that they can more easily be excited when the time comes. The seats should be comfortable, the auditorium quiet and at a suitable temperature; the lighting and colouring should be subdued.

\* Sound Services, Ltd.

While it is always difficult, and sometimes impossible to fulfil all these requirements, it must be remembered that the more we stray from them the more difficult it will be to hold the attention of the audience when the films are projected.

### The Commencement of the Film

It cannot be stressed too strongly that the first few minutes or even seconds in the showing of a film are the most critical. At this time no hold has been taken of the audience and in far too many cases they are profoundly aware of their surroundings. It is absolutely essential that a flawless picture must be projected from the first instant and that the sound must be perfect and at the correct level if the aim of good presentation is to be achieved. Failure to do this will result in there being a delay before the members of the audience become lost in the film.

*A demonstration of the correct and incorrect opening of a film was given.*

For the two openings of a film just demonstrated two similar equipments and two prints of the same film were employed, all of which were as nearly similar as could be arranged. The only differences were in the timing and in the manipulation of equipment by the projectionist. I would like to draw attention to the timing of putting out the auditorium lights and projecting the picture. In my opinion, a valuable air of expectancy is created if the auditorium lights are dimmed appreciably before anything at all is projected on to the screen. The degree of dimming or even total extinction is a matter of choice. Also noticeable was some stray light which entered the auditorium; this was not accidental.

### The Picture

There is no need to dwell very long on the necessity for projecting a picture which is clear, bright and steady. Such a picture can only be obtained from a first class print, good equipment properly adjusted and a projectionist who knows his job and does it well. I will confine myself to the last requirement, as the first two come within the terms of

reference of the other Committees of Investigation.

Perhaps the most important consideration and certainly the one which is controlled by the greatest number of factors, is the picture size. A good working basis is to have a screen width equal to one-sixth of the distance to the back row of the seats. The front row of seats should never be nearer to the screen than 120 per cent of the picture width for a matt screen and 250 per cent of the picture width for a beaded or silver screen. It is, however, essential that the picture is adequately illuminated, and for 16 mm. film presentations a figure of 5 lumens/sq. ft. incident upon the screen is generally accepted as a minimum figure. This means that the average post-war 16 mm. projector can satisfactorily illuminate an 8 ft. picture. This low amount of illumination, as compared with the 35 mm. cinema, has only been accepted because of lack of better projectors.

The use of a beaded screen can, in certain conditions, compensate for lack of illumination. The beaded screen has directional properties which result in a high brightness gain within a total viewing angle of 40°, and can be used to advantage in a narrow auditorium, but it is inadequate in the average hall unless the seating of the audience is carefully controlled. (Fig. 1).

It will be seen from the intensity distribution for the beaded screen (Fig. 2) that the projector must be on the same level as the audience, whereas in the case of the matt screen, the screen itself should be at audience level. (Fig. 3). The silver screen has specular characteristics which are not usually an advantage, and it does not have the same brightness gain as the beaded screen. (Fig. 4).

The matt or diffusing screen is most commonly used because it is the best in the greater number of halls. It is also practical to have the front row of the audience nearer to the screen than for beaded or silver screens, where non-uniform brightness over the screen would be very noticeable. (Fig. 5).

The next important matter under the heading of the picture is the screen drapes. It has

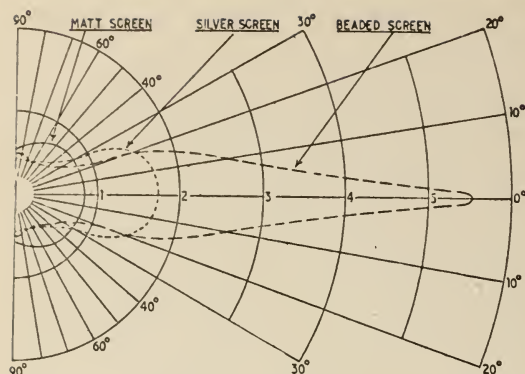


Fig. 1. Comparative brightness patterns for three types of screens.

been the custom as long as I can remember, and probably since the earliest days of the cinema, to surround the screen with a black masking. It has also been well known for a long time that it is bad for the eyes to view

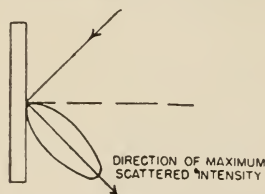


Fig. 2. Intensity distribution for a beaded screen.

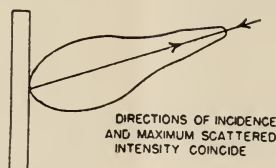


Fig. 3. Intensity distribution for a matt screen.

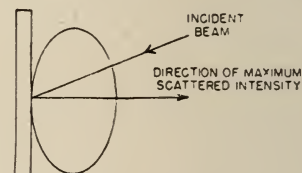


Fig. 4. Intensity distribution for a silver screen.

a highly illuminated object under the condition of darkened surroundings. Eye fatigue and strain will be reduced if some form of peripheral lighting is provided without changing the illumination of the central object,

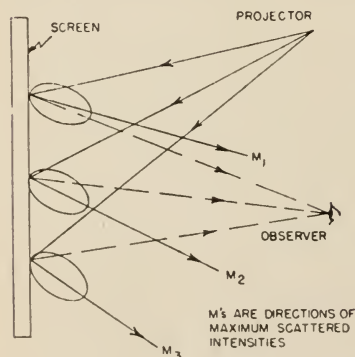


Fig. 5. A silver screen showing how the intensity distribution results in serious non-uniform brightness to an observer near to the screen.

which in our case is the screen. The Telekinema was up-to-date in this respect<sup>1,2</sup>, having an illuminated surround to the picture, and was, I believe, the first attempt made in this country to overcome somewhat primitive ideas. With portable 16 mm. equipment it is not always desirable, or even practicable, to carry additional equipment around, but a compromise can easily be reached. This evening, for example, I have provided grey screen drapes.

Before leaving the subject of screen drapes I should mention the Synchron-screen, which was recently demonstrated in this country. I see no reason why a modified version could not be produced for portable 16 mm. screens. This screen, shown in Fig. 6, was recently described<sup>3</sup> as consisting of "a motion picture screen with contiguous reflecting side wings, top and bottom panels. The picture surround surfaces synchronously fluctuate in

light intensity and colour with the changes in picture light and colour adjacent to the reflecting surround areas. There is an appreciable increase on the subtended angles of the luminous field of view of the theatre patron. A luminous, maskless stage setting is thus created for the viewing of motion pictures."

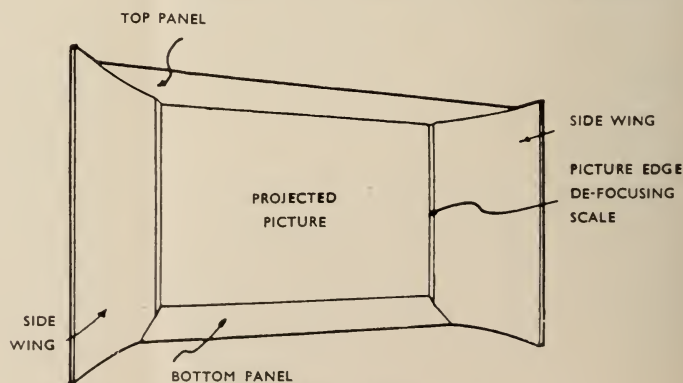


Fig. 6. The Synchron-screen.



## The Reproduction of Sound

A great deal has been written about the reproduction of sound, but generally reference has been made only to getting perfect sound from the loud speaker and not to other factors which are equally important. The first of these is the positioning of the speaker. The user of 16 mm. film generally has to content himself with a light weight and portable loudspeaker, which excludes the use of horns or the highest quality cone speaker. All cone speakers have a pronounced high frequency beam and most 16mm. projection equipments have only one speaker. The best use has to be made of this one high frequency beam as obviously much reliance cannot be placed upon reflection of the higher frequencies. The only solution is to direct the loudspeaker on to the audience, which means placing it high up and to one side of the screen. Perforated screens are not favoured, as the perforations are obvious to the audience in the front rows. To avoid unwanted forms of resonance, the loudspeaker should not be positioned near any large flat reflecting surface.

It should not be necessary to say very much about the correct use of volume and tone controls except that a projectionist should always rehearse his films and decide his settings before the actual presentation. In the case of halls which are difficult acoustically it is a good idea for the projectionist to go into the body of the hall and judge for himself the quality of the reproduced sound.

One very important consideration which does not receive the attention it deserves is the presence of extraneous noise. Under this heading can be included projector noise, which many manufacturers of equipment have apparently only considered in a casual kind of way. Some forms of extraneous noise, such as traffic, cannot be easily subdued, but there is no excuse at all for the chattering projectionist or attendant.

A demonstration will now be given using two copies of the same film. In the first case the loudspeaker will be placed on the floor, the volume will be raised a little to compensate for bad positioning, and the

tone control will be incorrectly set at first and then changed to the optimum setting. There will be a little more extraneous noise than we should have. In the second case the projectionist will do his best.

*The demonstration followed.*

## The Set-Up.

The first essential of a good set-up is neatness. The projector on its stand cannot look tidy, but can easily be hidden by a simple form of booth. This has the added advantage of concealing the activities of the projectionist. All cables should be arranged out of sight if possible, and certainly where they will not inconvenience the audience. This means that 100 ft. of speaker cable is often required where the throw is only 40 or 50 ft.

The screen end of the auditorium has already been discussed but without reference to concealing the loudspeakers, which is well worth while. Mention should be made of a portable proscenium complete with lights and motor controlled curtains. This unit packs into a surprisingly small box for transit. The longest size which includes an 8-ft. wide screen only measures 10 ft. 6 ins. by 12 ft. by 12 ft. when packed. Great credit is due to the designers and manufacturers of this valuable piece of equipment.

Finally, under this heading should come the arrangement of the seating and positioning of the screen. Every effort should be made to give each member of the audience an uninterrupted view of the screen. Gangways should be arranged so that they absorb a minimum of good viewing space. If the projected beam clears the heads of the seated audience, as it always should, a central gangway can with advantage be avoided but the dimensions of the auditorium will have a major influence upon the number and positions of gangways. With regard to the screen, the bottom edge should preferably be at least 4 ft. 6 ins. from the ground, although in the case of a small auditorium the screen may be a little lower, and in a large auditorium higher. In the latter case it is necessary to increase the distance between the screen and the front row if the physical discomfort of some of the audience is to be avoided.

There are many aspects and problems associated with the presentation of 16mm. films which I have only just touched upon or even omitted, but there is one thing which must not be left out. If 16mm. films are to be consistently presented at a high and creditable standard, there must be continuous and painstaking effort on the part of everyone concerned. What is more, the higher the standard obtained, the more noticeable becomes the smallest flaw, and consequently the greater still is the effort required. A poorly made join can be very noticeable if the

general standard is good. On the other hand it may easily pass unnoticed if there are a sufficient number of other faults.

Whilst the projectionist is a key man, he is dependent upon those who maintain his equipment and transport, he has to rely upon the film examiners and inspectors to see that his prints are in a first class condition, and lastly he would be lost without the planning which is necessary before any film show is given. This all means that good presentation can only result from good and enthusiastic team work.

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#### DISCUSSION

R. H. CRICKS : There is one point which I think is very important, that one can hear the projectors all the time. We in the trade get used to it, but the public do not. People say they cannot hear a word because of the noise of the machines. Now, I am not blind to the difficulties. Does Mr. Hind think it quite impossible to have a sound-proof box? I hoped when I came in here and saw quite a nice set-up that we had got it to-night. I was disappointed.

THE AUTHOR : It is not impossible to have a sound-proof box, but you have to face the practical side. Sound-proof boxes are very heavy and cumbersome things to carry around. An easier solution to my mind is the production of a sound proofed projector. I mentioned that the manufacturers have not yet given sufficient attention to the problem but they are now realising the necessity of sound-proofed projectors, particularly for class room work where the rooms are very reverberant and projector noise is most disturbing.

W. J. HUMBERSTONE : I should like to compliment Mr. Hind on the grey drapes. They are the best thing I have seen.

A. GREENWOOD : The grey drape is very pleasant when the picture is on the screen, but I was conscious of the picture on the drapes in the first film, and I wondered whether it would have been so noticeable had it been a black drape.

THE AUTHOR : No, it would not have been so noticeable. In the first instance you noticed it because we had introduced a faulty track on the projector. You have to be very careful to get the edge of the aperture just overlapping by a very small amount. I do not think you would notice it very much then.

N. LEEVERS : Could plastic material be used to help in keeping the grey drapes clean?

THE AUTHOR : That is probably the answer.

G. M. WOOLLER-JENNINGS : Have you any comments to make about one part of presentation we have not seen to-night, that is the use of dual machines?

How does Mr. Hind suggest overcoming the almost inevitable hiatus there is at the switchover?

THE AUTHOR : There should be no hiatus whatsoever. If you use two machines, and assuming that the films have Academy leaders and cue marks, there should be no difficulty. There is one important point. You must have a manual dower on your lamp and not rely on the lamp switch to put your lamp on and off.

M. RAYMOND : What do you think of the various large spools?

THE AUTHOR : I have nothing particularly good to say for them, except that they save the expense of buying a dual equipment. From what I have heard, they can be most unkind to films.

R. H. CRICKS : It appears to me that the chief trouble is not on the projector but the fact that renters do not supply films wound on big spools and they have to be cut to pieces or joined together. In other words, it is the projectionist and renter rather than the equipment.

THE AUTHOR : Another point is that unless there is a very well designed take-up it can cause further trouble to your films.

M. RAYMOND : The pull-down too can cause film damage.

THE AUTHOR : If the film has been out on hire for a long time and has not just come from the Library, it must have collected quite an amount of dirt. By the time the end is reached the presentation can be marred by the fluff around the gate and the scratching of the film through the last reel or two.

J. MASTERTON : Mr. Hind quoted a figure of 120 per cent. as being the distance of the nearest front row seat to the screen. Doesn't that seem a little close. I understood that distance between the front seat and the screen should not be less than  $2\frac{1}{2}$  times the width of the screen.

THE AUTHOR : The absolute nearest is 120 per cent and with a matte screen it is as near as you can get. It is 250 per cent with a beaded screen.



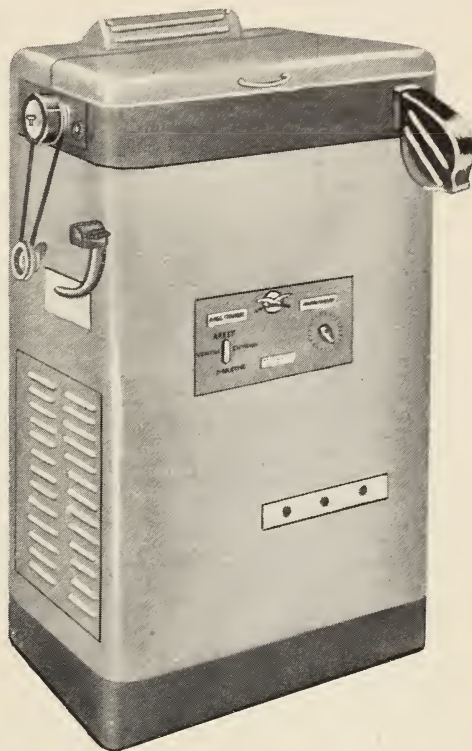
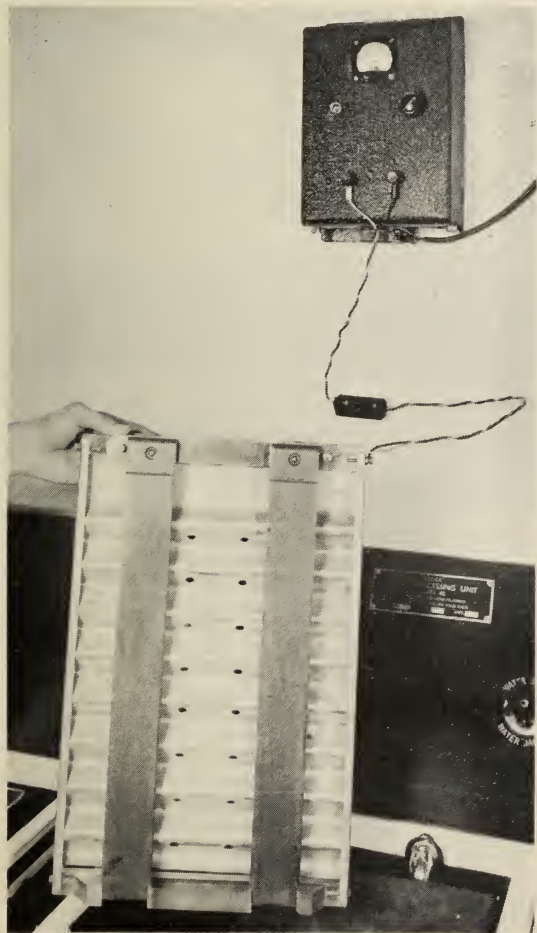
## NEW EQUIPMENT

*As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of news items does not constitute an endorsement.*

### THE BAKER ELECTROLYTIC HYPO UNIT

Baker Platinum, Ltd., of 52 High Holborn, London, W.C.1, have produced a small silver recovery electrolytic unit of great simplicity which would be suitable for a small laboratory or for a pilot plant, such as is run by many of the larger film laboratories. It consists of a wall mounted rectifier unit and an electrode assembly on stainless steel brackets for suspending in the actual developing tank.

Many stills departments would quickly recover the low first cost of such a unit in the amount saved in regenerated hypo, apart from the silver recovered. Careful arrangements have been made and special transit cases are provided for the despatch of used electrodes and the return of fresh sets. The whole weight of silver recovered is credited to the user less a very small refining charge.



### THE "AIGLONNE"

The "Aiglonne" automatic processing unit, produced by Etabl. André Debric, Paris, and marketed in this country by Cinetech Limited, Greenford, London, is completely revolutionary in design.

Similar in appearance to a domestic refrigerator it is only 4 feet high and occupies 2 ft. 6 ins. by 2 ft. floor space. Within these small dimensions is a complete daylight processing plant for 35 mm. or 16 mm., which needs connecting only to a power point and a water mixing point. The complete electrical requirements of the unit is 0.75 Kw.

The machine is sprocketless, being driven by a single shaft with friction rollers. High speed developing is possible — Plus X, for example, can be developed in  $1\frac{3}{4}$  mins. at 68 F., and at higher temperatures a much shorter time is possible. Magazines are used to feed the machine — the feed itself being automatic once started. The speed of processing can be varied over the range 200 to 710 ft./hr. Temperature is controlled within 0.5 F. The solution tanks are fitted with individual diaphragm pumps and can be replaced while the machine is operating.

For the television intermediate system, for pilot plants, and for the armed services where a really quick answer is required, the "Aiglonne" machine appears to fulfill a long-needed want.



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## BOOK REVIEW

*Books reviewed may be seen in the  
Society's Library*

**Mr. RANK : A STUDY OF J. ARTHUR RANK  
AND BRITISH FILMS.** *Allan Wood. Hodder  
& Stoughton, Ltd., pp. 282, 20s.*

A journalist's account of the history of British Film Finance and production over the last twenty years, with a full sized and highly coloured portrait of Mr. J. Arthur Rank surrounded by thumb-nail cameos of other leading personalities in the industry. It is difficult to access the purpose of writing this book. It contains little that is not already known to those in the film industry and much that is of no interest to those outside it. Nevertheless the author is refreshingly accurate in his facts although controversial in his opinions. He gives a broad summary of the economic and other difficulties that have confronted and still confront film production in this country and records the unhappy effects of Government interference and overburdening taxation.

## SITUATION VACANT

Maintenance Engineer-Electrician, required by film laboratory, able to do milling and turning, preferably with knowledge of cinematograph machinery, Union Rates. Phone PROspect 1073.

## INTERNATIONAL STANDARDS CONFERENCE

### Addendum

The Secretary of the International Conference on Cinematograph Standards has now received confirmation that in the proposed international standard the widths of 35mm. and 16mm. low shrinkage raw stock will be 35.00mm.  $\pm 0-0.05$ mm. and 15.95mm.  $\pm 0.03-0.02$ mm.

The original figures given in the report of the International Conference<sup>1</sup> should be amended accordingly.

### REFERENCE

1. International Conference on Cinematograph Standards, *Brit. Kine.*, 21, 89, 1952.

## PERSONAL NEWS OF MEMBERS

The President has been appointed Technical Adviser to the Royal Naval Film Corporation.

Stanley Schofield (Member) has recently completed and opened the new headquarters of his company, Stanley Schofield Productions Ltd. at 6 Old Bond Street. As would be expected, showmanship and a high standard of film presentation have an important bearing on the design of this new 16mm. centre.

E. E. Blake (Hon. Fellow) has been awarded a Fellowship of the Society of Motion Picture and Television Engineers.

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